Rapport annuel 1997

CIRAD-CP
Programme hévéa

RAPPORT D'ACTIVITES 1997

PROJET SRAP
GAPKINDO-CIRAD-CP -ICRAF, Bogor
Décembre 1997

Eric Penot
Programme hévéa, Indonésie, Décembre 1997

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RESUME

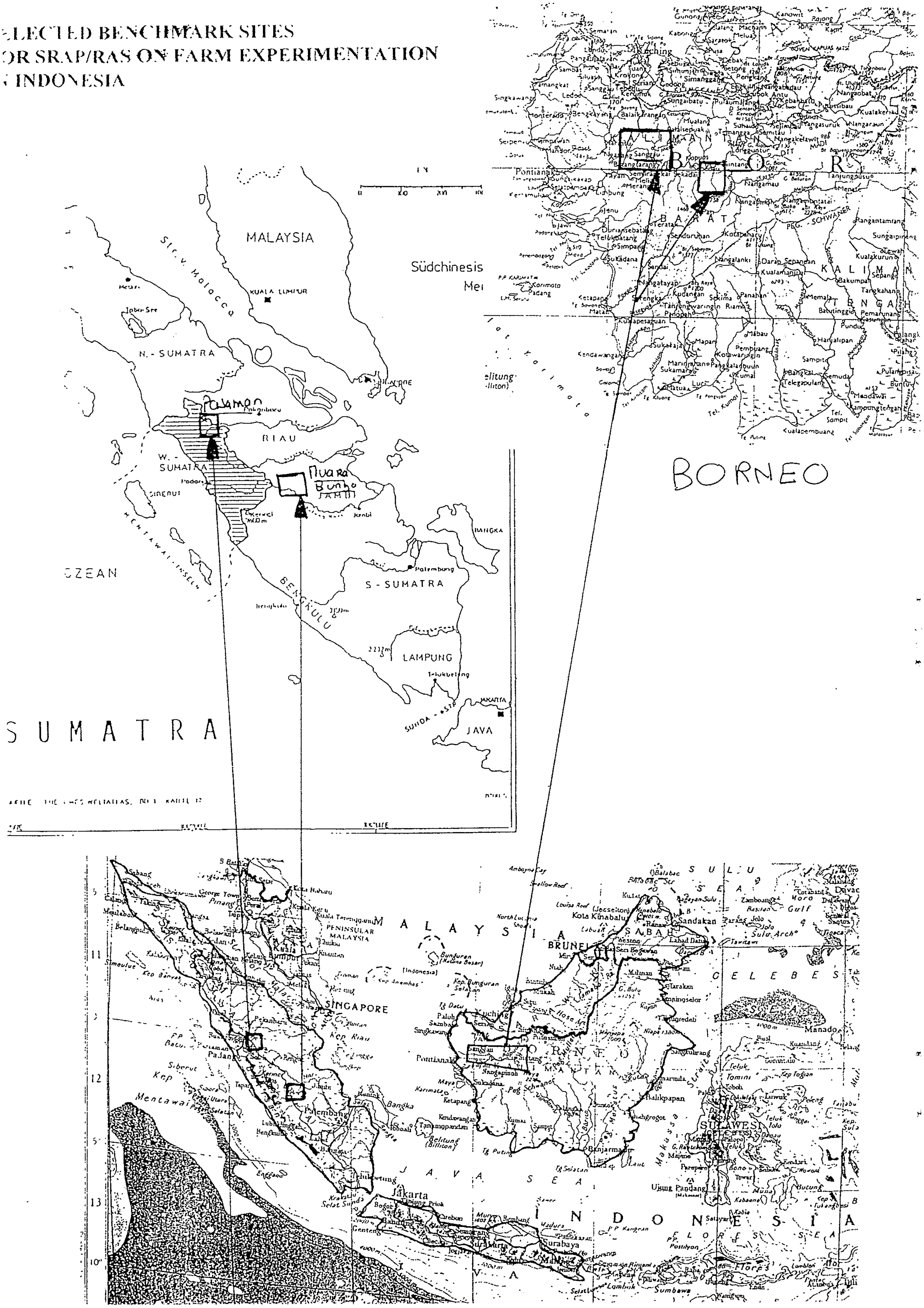
Le SRAP est maintenant agé de plus de 3 ans. Les experimentations en milieu paysan avec approche participative ont toutes été mises en place entre fin 1994 et fin 1996. 1997 a été une année de consolidation du projet, de suivi des 100 parcelles d'essais mises en place dans les 3 provinces (Sumatra Ouest, Jambi et kalimantan Ouest), ainsi que des 13 jardins a bois communeautaires experimentaux, et de réalisation d' un certain nombre d'enquêtes socio-économiques sur la production de materiel végétal (West Kalimantan) et la caractérisation des systèmes d'exploitation à (Jambi et West Kalimantan) avec la participation de 3 étudiants francais (ENGREF, ENSAR et ENITAB)sur des stagesde 6 a 8 mois.

Le financement USAID du SRAP se terminant en septembre 1997, un whorkshop a été organisé à Bogor à cette date afin de présenter à l'ensemble de la communeauté scientifique, des institutions de développement indonésiennes et de certains bailleurs de fonds (USAID et Banque Mondiale) les principaux résultats et les axes de recherches futurs.

La seule mission à l'étranger a concerné la prise de contact avec Kasetsart University/Bangkok et Prince of Songkla university/Hatyai, en Thailande, dans le cadre du projet INCO, avec l'aide de ICRAF/D Thomas et CIRAD, JC Vincent et R Lacote.

Les travaux du SRAP et de la Rubber Agroforestry Initiative ont pu etre présentés lors d'un workshop SRAP de 2 jours organisé par l'auteur a Bogor en septembre 1997

ELECTED BENCHMARK SITES
OR SRAP/RAS ON FARM EXPERIMENTATION
INDONESIA



1 INTRODUCTION

L'auteur est détaché à temps complet à l'ICRAF depuis septembre 1994 sur le projet SRAP (Smallholder Rubber Agroforestry project), un projet conjointement mené par GAPKINDO, (Association des proffessionnels du caoutchouc en Indonésie), ICRAF (International Centre for Research in Agroforestry) et CIRAD-CP.
Le coeur du rapport sera constitué du rapport annuel ICRAF 1997, en anglais, de ce projet. Une première partie en francais rappellera les principales activités générales de l'agent au cours de l'année, incluant celles qui ne concerne pas spécifiquement le projet SRAP mais qui concerne le CIRAD.
Le SRAP est toujours rattaché au programme 4 de l'ICRAF "systems improvment" qui a été remanié en 1997 (voir annexe 15). La composition de l'équipe et des programmes ICRAF du programme régional Asie du Sud est aussi présenté en annexe 15.

Le **projet SRAP/Indonésie**

Le SRAP (Smallholder Rubber Agroforestry Project) est un projet de recherche développé en commun par le CIRAD-CP (programme hévéa), le GAPKINDO (association des professionnels du caoutchouc en Indonésie) et l'ICRAF (International Center for Agroforestry) depuis aout 1994 et basé à Bogor, Java-ouest en Indonésie..
Le caoutchouc indonésien (2e) producteur mondial) est essentiellement produit par les petits planteurs (75 % de la production), couvrant prés de 3 millions d'hectare (84 % de la superficie totale en hévéa) principalement sous une forme trés extensive : le "jungle rubber" une agroforêt complexe à hévéa (qui couvre 2,5 millions d'ha). Certains projets de développement (TCSDP[1] et NES). Cependant, 15 % seulement des petits planteurs ont eu accés à ces innovations techniques (clones, fertilisation et vulgarisation) à des couts qui ne permettent pas de généraliser de type de développement à l'ensemble des planteurs indonésiens.
L'objectif principal du SRAP est d'identifier les composants d'un système agroforestier complexe basé sur l'hévéa qui serait, d'une part, à niveau d'intrants et de main d'oeuvre limités, donc d'un cout d'implantation inférieur à celui des projets de développement actuels, tout en conservant les avantages des systèmes agroforestiers traditionnels indonésiens, en particulier en terme de biodiversité, d'environnement et de diversification du revenu (une agroforêt complexe produisant également des fruits, du bois, du rotin, des cultures intercalaires annuelles en période immature...). L'objectif est également d'identifier des itinéraires techniques qui soit relativement proche des systèmes actuels, en particulier en terme de temps de travaux, afin d'optimiser l'adoption des innovations par les planteurs. Un réseau d'essais en milieu paysan a été mis en place dans 3 provinces à Bornéo (Kalimantan-ouest) et Sumatra (Jambi et Ouest-Sumatra), avec 62 parcelles afin de pouvoir tester en conditions réelles un certain nombre d'hypothèses techniques, avec des niveaux d'intensification croissants, éssentiellement basé sur la problématique de l'introduction du

[1]TCSDP = Tree Crop Smallholder Development Project, avec des paysans locaux et NES = Nucleus Estate Scheme, avec des paysans en transmigration.

matériel végétal clonal pour l'hévéa en combinaison avec des cultures annuelles (riz pluvial principalement) et pérennes (arbres associées fruitiers ou à bois de qualité supérieure) ainsi qu'avec une sélection de plantes de couvertures nécéssitant un faible niveau de maintenance.
Parrallèment à cette expérimentation en milieu paysan avec approche participative, sont réalisées des enquêtes sur les systèmes d'exploitation afin de connaitre les contraintes et opportunités d'adoption des innovations techniqes proposées et de pouvoir identifier une typologie opérationelle de situations et des systèmes de productions qui pourrait ultérieurement constituer une base de développement.
Les résultats attendus sont d'une part, à travers une recherche plus stratégique avec des étudiants en thése ou des experts associés (biodiversité et compétition hévéa/recru forestier en particulier), une meilleure connaissance des phénomènes de compétition, et d'autre part l'identification des composants simples des systèmes testés RAS (Rubber Agroforestry Systèmes) pour des recommendations techniques pouvant être développées ultérieurement à une plus large échelle, et enfin, une typologie opérationelle de systèmes d'exploitation.
Des méthodes de multiplication de matériel végétal par les petits planteurs seront également testées en milieu paysan alors que la principale innovations de ces systèmes est l'introduction de clones d'hévéa à forte productivité dans des environnements de type agroforestiers Le développement des activités du projet dans ces trois provinces permet de couvrir un large éventail de situations physiques (zones forestières, zone dégradée de type savanne à Imperata et zone de transmigration) et socio-économiques avec des populations et des niveaux d'accés aux innovations techniques différents.
Outre le GAPKINDO et l'ICRAF, le SRAP a développé une coopération avec un certain nombre de projets locaux en particulier avec la GTZ (projet SFDPà West-Kalimantan et Pro-KLK à West-Sumatra), certains partenaires privés (GOODYEAR), et des institutions de recherche : le BPS, station de recherche hévéicole de Sembawa (Sud sumatra) et le CRIFC/AARD de Bogor (centre de recherche sur les cutures annuelles). Le SRAP a été financé par GAPKINDO, ICRAF and USAID pour 1996/1997.
En principe, le financement des activités du projet pour 3 ans à West Kalimantan est en cours de négociation avec USAID via le GAPKINDO, idem pour la provice de Jambi.

Financements

	phase I 1994/96	phase II 1996/97	phase III 1997-200 (en négociation)
USAID	0	247 000	350 000 West kalimantan 150 000 Jambi
GAPKINDO	20 000	5 000	???
ICRAF	15 000		26 000
GTZ (2 projets) / LOGISTIQUE	10 000 (estimation)	5 000	5 000
CIRAD	mise à disposition d'un chercheur à plein temps.	idem	idem

2 Principales activités et personnes rencontrées.

JANVIER
- 1-24 Janvier : congé hivernal.
Rédaction de la demande de financement du projet pour INCO
Redaction des questionaires des enquetes socio économiques

FEVRIER
17 au 28 février : mission de terrain sur Jambi et West Sumatra.

Rencontre avec le nouveau directeur du projet Pro-RLK/GTZ de West Sumatra, notre partenaire local. Visite faite conjointement avec un scientifiaque de IBSRAM (Thailande)

MARS
- 3 au 13 mars : mission d'appui a West Kalimantan
- 14 mars : réunion USAID, Jakarta, pour la preparation du futur projet NRP phase II sur West Kalimantan. Réunion CSAR, Bogor.

Préparation dossier INCO
Rédaction de la demande de financement du SRAP par CFC/IRSG.
Première rédaction de la demande de financement USAID pour 1998.
Rédaction d'articles.

- 28-30 mars : réunion de la commission de site CIRAD à Bali.

AVRIL
- 3 avril : Réunion générale ICRAF-ASB (Alternatives to Slash and Burn)
- 4 : départ en France
- 7 au 11 avril : formation au logiciel WINSTAT.
- 14 au 26 : Réunions diverses CIRAD-CP, Forêts et ZTH + congés.
- 24-30 avril : mission d'appui Jambi.

Arrivée du stagaire ENITAB, W Shueller. Préparation bibliographique.

MAI
- 20-26 mai : mission d'identification de collaboration et d'experimentation en milieu paysan des systèmes RAS en Thailande, dans le cadre d'une future collaboration avec le financement INCO. Rencontres au CIRAD/Bangkok, à Kasetsart University et PSU University in Hat Yai. Visite de terrain dans la zone Sud.

Rédaction de publications et traitement des données;

Dossier INCO.
Reception des étudiants ENSAR et ENGREF.
Stage de langue indonésienne des stagiaires.

- 31 mai : mission audit CP

JUIN

- 9 au 20 juin : mission d'appui terrain et mise en place des stagiaires a West Kalimantan (ENGREF/Phillipe Courbet et ENITAB/W Shueller).: avec invitation de Patrice Levang (ORSTOM) et un staff de la transmigration en particulier pour la visite de nos essais de réhabilitation des savannes à Imperata en zone de transmigration originellement basée sur les systèmes de culture pluviaux.

- 23 au 27 juin : séminaire ICRAF "Indigenous strategies for intensification of shifting cultivation in Southeast Asia". Bogor. Présentation d'un papier : . *From shifting agriculture to sustainable rubber complex agroforestry systems (jungle rubber) in Indonesia: an history of innovations production and adoption process.*

- du 26 juin au 4 juillet : mission d'appui a Jambi. Visite de Jean Marie Eschbach. Instalation du stagiaire ENSAR, Alexandra Kelfoun.

JUILLET

- 7-9 juillet : participation au séminaire STD III CIRAD/IRRI , Sembawa, South-Sumatra. Traitement des données et préparation du workshop SRAP.

-19 juillet-3 aout : congé en Indonésie

AOUT

-2 aout : Séminaire GAPKINDO. Préentation des travaux en cours. Rapport sur le séminaire : *Compte rendu du Forum GAPKINDO 1997.*

Traitement des données SRAP.
Préparation du workshop SRAP.
Rédaction de 3 articles.

-18-22 Aout et 22-25 aout : participation au séminaire ASB/ICRAF.
Reunion générale programme régional Asie du Sud est avec la direction ICRAF de Nairobi. Revue des principaux problémes et identification d'une stratégie à 5 ans.

-28 Aout : départ en France.

SEPTEMBRE

- 1-6 septembre : Participation aux journées du CIRAD et du CIRAD-CP.
- 8-17 septembre : contacts divers, CP et ZTH, séminaire ATP-Dynfor (2 jours), finition du dossier INCO (4 jours)
- 21 septembre : retour sur Jakarta

Préparation Workshop SRAP
Redaction article commun avec Dr Busiman pour conférence IFC/Kuala Lumur.

- 29-30 septembre : Workshop SRAP a Bogor.

OCTOBRE

- 1-3 octobre : séminaire interne SRAP.
Preparation du manuel RAS. Revue des articles présentés

Appui a la rédaction des mémoires des étudiants ENSAR et ENITAB
Rédaction article pour workshop CIFOR.

- 9 octobre : visite Jean Luc Maurer (IEUDS/Genéve)
- 16-18 octobre : Séminaire SRAP avec les paysans du projet a West Kalimantan.

Finition article pour PRD.
Préparation article pour séminaire ICRAF sur 'tree domestication".

-28-29 octobre : séminaire Banque Mondiale sur le projet régional de développement de la province de Jambi. Jakarta

NOVEMBRE

- 4 novembre : séminaire "cacao" avec F Ruf. Jakarta.

- 5 au 7 novembre : séminaire ICRAF " tree domestication", Wanagama, Jogyakarta.

-12 novembre : meeting avec USAID et NRPM II a ICRAF/Bogor.

-17-19 novembre : séminaire CIFOR "secondary forests management".
Présentation d'un papier commun avec Silvia Werner (Banque Mondiale) : *Prospects for the conservation of secondary forest biodiversity within productive rubber agroforests.*

Appui a la rédaction du mémoires de l'étudiant ENGREF
Traitement des données West kalimantan.

DECEMBRE
Rédaction du rapport scientifique final sur les essais en milieu paysan a West Kalimantan..
Rédaction du manuel technique "RAS", version provisoire
Rédaction du rapport activités ICRAF 1997 et CIRAD 1997.

- 16 décembre : réunion ICRAF avec Mr Rouilly d'Orfeuil.

- 22 décembre : départ en France pour congé hivernal.

3 EVOLUTION DES ACTIVITES AU SEIN DU SRAP ET DE LA "RUBBER AGROFORESTRY INITIATIVE"

3.2 Travaux réalisés directement du sein du SRAP

1) Experimentation en milieu paysan des systèmes RAS

Une première synthése des résultats technique apres 3 années à West Kalimantan et 2 années à Jambi sont présentées en annexe dans le rapport en anglais pour ICRAF voir annexe 2. Un manual technique RAS est en cours de finition qui sera publié a large echelle (500 a 1000 exemplaires) en 1998 et co-financé par Ambassade de France à Jakarta et Winrock International.
Aucun essai nouveau n' été plantéen 1997 et les données collectées sur la croissance de l'hévéa, des cultures intercalaires et de la survivabilité des arbres associés ont été traitées et seront publiées dans un rapport interne en janvier 1998 pour West Kalimantan et en avril pour Jambi et West Sumatra.
Une synthèse des principaux résultats est disponible dans les papiers présentés lors du workshop SRAP deseptembre 1997.

2) Programme "jardin a bois villageois" et étude de la disponibilité du matériel végétal clonal d'hévéa dans les provinces de West Kalimantan et de Jambi.

L'étude a été réalisée par un étudiant de l'ENITAB, Wilfried Shueller, pour West Kalimantan et par Iwan Komardiwan (staff SRAP) et E Penot pour Jambi. La partie concernant West Kalimantan a été publiée sous la forme d'un mémoire de fin d'etudes ENITAB/Bordeaux
L'étude montre la trés faible qualité et pureté clonale du materiel végétal clonal produit par les paysans pépiniéristes privés en sous traitance pour le Dinas Perkebuan (service de vulgarisation pour les cultures pérennes). Elle traite aussi de l'expérience SRAP de mise en place de jardins a bois villageois (communautaires) et montre clairement quelles sont les conditions pour que cette activité se developpe et permette ainsi l'accés à du materiel

végétal de bonne qualité a un cout moindre.
La partie concernant Jambi sera publié sous la forme d'un rapport pour la Banque Mondiale pour le projet de développement régional de Jambi en mars1998.

3) Enquetes de caractérisation des systèmes de production agricoles

Les enquetes onte été realiséespar 2 étudiants de ENGREF/CNEARC Montpellier, Phillipe Courbet, pour West Kalimantan, et de l'ENSAR/Rennes, Alexandra Kelfoun, pour Jambi. la méthodologie a été préparée en commun a Bogor sous la direction de l'auteur, sur la base des enquetes préalables réalisées à East Pasaman, West Sumatra entre janvier et mars 1997 par Iwan et E Penot. Le logiciel utilisé est WINSTAT. Les enquetes portent sur la descriptiopn et l'analyse économique des systèmes de production et l'analyse des contraintes d'adoption des innovations techniques, pour les paysans SRAP et les paysans hors projet sur un échantillon total de 223 paysans dans les 2 provinces.
Un résumé des résultats a été publié lors du workshop SRAP de septembre 1997.
Les travaux finaux ont été publiés sous la forme de mémoires de fin d'etudes.
Une étude globale reprenant l'intégralité des résultats sur les 3 provinces sera effectuée en 1998, avec identification d'une typologie opérationelle globale pour les institutions de developpement.

4) Essai d'experimentation sur la compétition entre hévéa et arbres associés

Cet essai specifique a été implanté sur la station de Sembawa, Sud-Sumatra, sous la direction de Gede Wibawa. Le plan de l'essai est présenté en annexe 7.

5) Etude des strétagies paysannes face a différents type de projets de développement hévéicoles en Indonésie.

Cette étude, initiée à la fin de 1997, sera réalisée sur le terrain a West kalimantan et Jambi, sous la direction de E penot et F Ruf , en 1998/99 par une étudiante francaise en thése de l'Université de Toulouse, Bénédicte Chambon, qui débutera ses travaux de terrains en février 1998. Le sujet de l'étude est présenté en annexe 8.

6) Etude sur la valeur économique des composants écologiques des systèmes agroforestiers complexes à base d'hévéa.

Cette étude est réalisée à West Kalimantan par un étudiant allemand en thése, Franz Gaezwiller, Université de Berlin, avec la collaboration de Tom Tomish, ICRAF (repo,nsable du programme1, "impact et caractérisation"). Le sujet de l'étude est présenté en annexe 9 et tentera de chiffer les composantes écologiques des differents systèmes incluant par ailleurs les RAS au sein d'une matrice de type socio-économique.

7) Participation a l'ATP DYNFOR/CIRAD

Depuis 1996, le projet contribue a l'ATP Dynfor par le biais de 2 publications (déjà présentées par ailleus lors des séminaires ICRAF et CIFOR).
Le théme de rattachement est le suivant :

Thème de rattachement et axes de réflexion ATP dynfor:

☐ **Définitions, échelles d'observation, indicateurs**
- ☐ *définitions, représentation, perception forêt, déforestation*
- ☐ *confrontation échelles d'observation et instruments de mesure*
- ☐ *indicateurs de viabilité (couvert forestier, biodiversité, gestion)*

☐ **Modes d'exploitation, population, dynamique forestière**
- ------> ☐ *systèmes agroforestiers / jachères ligneuses /transition forestière*
- -------> ☐ *systèmes agricoles et gestion de l'arbre, population*
- ☐ *élevage, occupation des terres et couvert boisé*
- ☐ *interactions exploitation forestière et autres usages*

☐ **Espaces, ressources, appropriation**
- ☐ *statut de l'arbre, foncier, appropriation*
- -------> ☐ *appropriation et espace en zone de fronts pionniers*

☐ **Processus de décisions, institutions, organisations, marchés**
- ☐ *institutions, politiques et contextes socio-économique*
- ☐ *alternatives à déforestation et gestion à long terme*

Les 2 articles presentés sont les suivants :
- Penot E & Silvia Werner. *Prospects for the conservation of secondary forest biodiversity within productive rubber agroforests.* Publication presented at the CIFOR/USAID International Workshop on "management of secondary forest in Indonesia". Bogor, Indonesia, November 1997.

Penot E. *From shifting agriculture to sustainable rubber complex agroforestry systems (jungle rubber) in Indonesia: an history of innovations production and adoption process.* Paper presented to the ICRAF/Cornell University workshop on “indigeneous strategies for intensification of shifting cultivation in Southeast Asia”. Bogor, indonesia, June 1997.
Une collaboration est prévue en 1998 avec Francois Ruf et un article commun sur le thème 3.

3.2 Travaux réalisés au sein de la "rubber agroforestry initiative par ICRAF"

1) Analyse des compétition racinaires dans les systèmes RAS 1.

Ce travail, purement agronomique, est réalisé par une étudiante galloise en thése, Sandy

Willliams (Bangor University, UK), sous la direction de M Van Noordwijk (ICRAF), et avec l'aide de l'auteur (sur les systèmes RAS 1) , a permis de dégager un certain nombre de résultats qui seront publiés sous le forme d'une thése en avril 1998. Un résumé des résultats a été publié lors du workshop SRAP de septembre 1997 (2 papiers). Le sujet de l'étude et des essais specifiques hors RAS 1 sont présenté en annexe 10.

2) Essai interaction entre fertilization (P et K) et fréquence de nettoyage en RAS 1.

Cet essai est réalisé à Jambi. Les résultats, pas d'effet marqué de la fertilization de l'hévéa en systèmes RAS 1 sur les sols de plaines a Jambi, ont été publiés lors du workshop SRAP de septembre 1997.

3) Etudes des effets des techniques de brulis sur l'environement des sols.

Cette étude est réalisée a Jambi par une étudiante hollandaise en thése (Ohio state University), Quirine Kettering, dont une partie repose sur une enquete sur les pratiques culturales , réalisées en partie avec l'aide de l'auteur (pour le questionnaire de l'enquete) et en collaboration avec Alexandra Kelfoun. Les premiers résultats ont été publiés lors du workshop SRAP de septembre 1997 et feront l'objet d'une thése en 1999.
Le sujet de l'étude est présenté en annexe 11.

4) Etude de la biodiversité des jungle rubber et comparaison avec la foret primaire par le biais des fougères.

Cette étude est réalisée a Jambi par une chercheuse hollandaise associée ICRAF, Rien Bekuma. Une partie des résultats ont été publiés lors du workshop SRAP de septembre 1997 et feront l'objet d'une thése en 1999.
Le sujet de l'étude est présenté en annexe 12.

5) Effet de la compétition lumière et de l'intensité de nettoyage sur les systèmes agroforestiers a base d'hévéa.

Cette étude devait etre initialement réalisée à Jambi par un étudiante japonais en thése (Tokyo University), Mr Sadahisa Kato, réalisées en partie avec le soutien de l'auteur (pour la partie enquete). Il apparait que ce sujet sera finalement traité par un autre étudiant à partir de décembre 1997.
Le sujet de l'étude est présenté en annexe 13.

4 LE WORKSHOP SRAP septembre 1997. Bogor.

Un workshop de 2 jours a été organisé fin septembre 1997, à Bogor, par l'auteur et Gede Wibawa (IRRI/Sembawa), ainsi que tout l'équipe du SRAP, avec avec les représentants des principales institutions indonésiennes et internationales de recherce et de développement (80 personnes au total). Le programme et les intervenants sont présentés en annexe 3. La première journée a été consacrée aux présentations des publications, un résumé des activités du SRAP et de la Rubber Agroforestry Initiative. le seconde journée aété consacrée a une réflexiuon sur 2 axes : agronomie des RAS et évolution, RAS et politiques de développement, et biodiversité au sein des RAS.

Les publications provisoires ont été distribuées mais elles feront l'objet d'une refonte pour la publication des proceedings courant 1998 avec le concours financier de l'Ambassade de France a Jakarta, sous la direction de l'auteur et de Gede Wibawa..

Les principales contributions présentées ont été les suivantes :

- 1 - Introduction to SRAP methodology and concepts : summary of the preliminary results. by E. Penot, Team leader
- 2 - Main agronomic results of RAS on-farm experimentation network in West Kalimantan,
by E. Penot, Ir Sunario, Ratna Akiefnawati & Ir Hilahang. NOT INCLUDED IN THIS PACKAGE
- 3 - Main agronomic results of RAS on-farm experimentation network in Jambi,
by G. Wibawa, E. Penot, Ratna Akiefnawati, S. Williams.
- 4 - Main agronomic results of RAS on-farm experimentation network in West Sumatra, by Hisar Bihombing and Eric Penot NOT INCLUDED IN THIS PACKAGE
- 5 - Rubber Improved Genentic Planting Material (IGPM) availability and use by smallholders in West-Kalimantan Province
By W Shueller, E Penot, Ir Sunaryo.
- 6 - Farming system characterization and innovations adoption process in Jambi
by A. Kelfoun, E Penot & Iwan Komardiwan.
- 7 - farming system characterization and innovations adoption process in West-Kalimantan By Ph Courbet, E Penot & Ir Hilahang.
- 8 - Biodiversity in rubber agroforests
by Rien Bekuma
- 9 - Below-ground interactions between rubber and weeds in an immature RAS 1 type agroforestry system.
by Sandy Williams
- 10 - P fertilization in RAS 1
by Ratna Akiefnawati and Meine van Nordwick

- **11 - Slash and burn as land clearing method for rubber smallholders in Sepunggur, Jambi province, Indonesia.**
by Quirine M.Ketterings
12 **Rubber Agroforestry Systems : RAS 2 on farm experimentation in West Kalimantan : preliminary results of rice (local varieties in the first year of establishment) and in rice trials (RAS 2) planted betwen 1994 and 1997. Draft.**
By E. Penot
13 **Smallholder rubber plantations viewed through forest ecologist glasses. An exemple from South Sumatra.**
by Hubert de Foresta
14 **Biodiversity assessment of jungle rubber in West-Kalimantan.**
by SylviaWerner Not présented
15 **Land use changes in Jambi province in sumatra : an overview.**
by Fred Stole
16 **Preliminary conclusion summary paper**
by E. Penot & G. Wibawa

poster
- **17 - Rubber fertilization trial (RAS 1.3) in RAS 1 environent in Jambi province.**
By Gerhard Eli Sebastien
18 **Rubber IGPM availability and use in the Jambi province**
By Iwan Komardiwan and E. Penot
19 **Rubber roots shift to the subsoil when there is intercrops**
by S Wiliams, G Wibawa & M van Noordwijk

5 PUBLICATIONS

Un certain nombre de publications et rapports internes ICRAF ou CIRAD ont été présentées lors de séminaires, ou à des revues (PRD). La liste complete des publications SRAP est disponible en annexe 1. Les publications SRAP et celles de l'auteur pour 1997 sont les suivantes :

En cours de réalisation

Penot *E. Which kind of improved planting material for RAS (Rubber Agroforestry Systems) technology ?* ICRAF, Bogor, 1997. *Paper in progress.*

______ *Rubber Agroforestry Systems (RAS) methodology.* ICRAF, project paper. Final up-to-date version. Bogor, Indonesia, December1997. In press.

______*Main results in RAS experimantation in West Kalimantan.* In progress

Already released in December 1997

Penot E. *Associated trees with rubber in Rubber Agroforestry Systems (RAS).* paper presented at the ICRAF workshop on "domestication of agroforestry trees" Jogyakarta, Gadjah Madah University, Indonesia, 4-7 November 1997.

Contribution to "*ASB Indonesia phase 2 summary report*". ASB/ICRAF/Southeast Asia. Bogor

Penot E & Silvia Werner. *Prospects for the conservation of secondary forest biodiversity within productive rubber agroforests.* Publication presented at the CIFOR/USAID International Workshop on "management of secondary forest in Indonesia". Bogor, Indonesia, November 1997.

Penot E. *L'amélioration des agroforets à hévéa : un enjeu pour 1 millions de paysans en Indonésie.* To be published in CIRAD-CP PRD publication. December 1997, Montpellier, France. In Press.

Budiman A.F.S.& Penot E. *Rubber agroforestry in Indonesia.* Paper presented at the "International rubber conference 1997 : Rubber science and technology : improving quality of life". RRIM, Kuala Lumpur, Malaysia. October 1997.

Penot E. *Compte rendu du Forum GAPKINDO 1997.* Bali, August 1997. CIRAD internal report, Bogor, indonesia, August 1997.

______. *From shifting agriculture to sustainable rubber complex agroforestry systems (jungle rubber) in Indonesia: an history of innovations production and adoption process.* Paper presented to the ICRAF/Cornell University workshop on "indigeneous strategies for intensification of shifting cultivation in Southeast Asia". Bogor, indonesia, June 1997.

______. *From shifting agriculture to sustainable rubber complex agroforestry systems (jungle rubber) in the peneplains of Sumatra and Kalimantan in Indonesia: innovations in local rubber based cropping systems* Contribution to the World Bank report "Indonesia : upland agricultural technology study". Edited by F Ruf and F Lancon. CIRAD, Montpellier, France. February and November 1997.

______. *Annual report of SRAP, 1996. ICRAF/CIRAD-CP/GAPKINDO.* CIRAD internal Report. Bogor, Indonesia. March 1997.

Papers released for the SRAP WORKSHOP in september 1997.

E. Penot. *Introduction to SRAP methodology and concepts : summary of the preliminary results.* Paper presented at the ICRAF/SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, Bogor, Indonesia, 29-30th September 1997

E Penot, Ir Sunario, Ratna Akiefnawati & Ir Hilahang. *Main agronomic results of RAS on-farm experimentation network in West Kalimantan.* Paper prepared for the ICRAF/SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia. In Press.

E. Penot *Rubber Agroforestry Systems : RAS 2 on farm experimentation in West Kalimantan : preliminary results of rice (local varieties in the first year of establishment) and in rice trials (RAS 2) planted betwen 1994 and 1997.* Paper presented at the ICRAF/SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

E. Penot & G. Wibawa *Preliminary conclusion summary paper of the SRAP workshop on Rubber Agroforestry systems.* Paper presented at the ICRAF/SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

G. Wibawa, E. Penot, Ratna Akiefnawati, S. Williams. *Main agronomic results of RAS on-farm experimentation network in Jambi.* Paper presented at the ICRAF/SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Hisar Bihombing & Eric Penot. *Main agronomic results of RAS on-farm experimentation network in West Sumatra.* Paper prepared for the ICRAF/SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia. In press.

W Shueller, E Penot, Ir Sunaryo. *Rubber Improved Genetic Planting Material (IGPM) availability and use by smallholders in West-Kalimantan Province.* Paper presented at the ICRAF/SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

A. Kelfoun, E Penot & Iwan Komardiwan. *Farming system characterization and innovations adoption process in Jambi* . Paper presented at the ICRAF/SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Ph Courbet, E Penot & Ir Hilahang. *Farming system characterization and innovations adoption process in West-Kalimantan* . Paper presented at the ICRAF/SRAP workshop on.R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Iwan Komardiwan & E. Penot *Rubber IGPM availability and use in the Jambi province.* Poster paper presented at the ICRAF/SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

CONCLUSION

Les activités sont principalement concentrées sur le projet ICRAF/CIRAD/GAPKINDO SRAP. Ce projet , démarré avec de faibles moyens sur financement GAPKINDO (25 000 US $) et ICRAF (15 000 US $) pour les budgets opérationnels en 1994/1995 , puis sur un financement USAID (247 000 US $ sur 15 mois) a permis , d'une part de mettre en place un certain nombre d'essais en milieu paysan dans 3 provinces (Kalimantan-ouest, West-Sumatra et Jambi), de former deux équipes locales à Sumatra et Kalimantan, de développer des coopérations locales avec des instituts de recherche (PBS/Sembawa ou CRIFC/Bogor) et de développement (GTZ, ...) et, d'autre part, de développer des sujets plus pointus, tels la biodiversité, les problèmes de compétition entre arbres, le role du phosphore dans la croissance des arbres...avec la mise en place d'une véritable équipe multidisciplinaire à laquelle participent des chercheurs de ICRAF, CIRAD, ORSTOM, University of Nederlands, mais aussi des étudiants en PhD des universités de Bangor (UK) , Ohio (USA) et Belin (Allemagne).
Le projet doit normalement pouvoir continuer ses activités en 1998 sur la base d'un financement ICRAF limité en attente de l'obention d'un autre financement. Plusieurs pistesde recherche sont en cours dont USAID pour le NRMP 2 a West kalimantan, ASB pour Jambi et CFC/INRO pour les deux provinces. Une tentative de demande de financement INCO, soumise en septembre 1997, et une autre , Prix Philli pMorris, n'ont pas abouties.

Le temps fort de cette année 1997 a été bien sur été le workshop SRAP qui a permis d'une part de faire connaitre les systèmes RAS et les premiers résultats à l'ensemble de la communauté scientifique et celle du dévelopement, et, d'autre part, de favoriser une reflexion commune en terme de dévelopement et d'axes de recherche futures, qui a débouché sur une collaboration directe avec le projet de développement régional de la province de Jambi, directement financé par la Banque Mondiale. Cette collaboration se concrétisera par une série d'étude, en particulier sur les cash-flow des systèmes RAS et sur une enquete disponibilité du materiel végétal d'hévéa dans la province de Jambi.

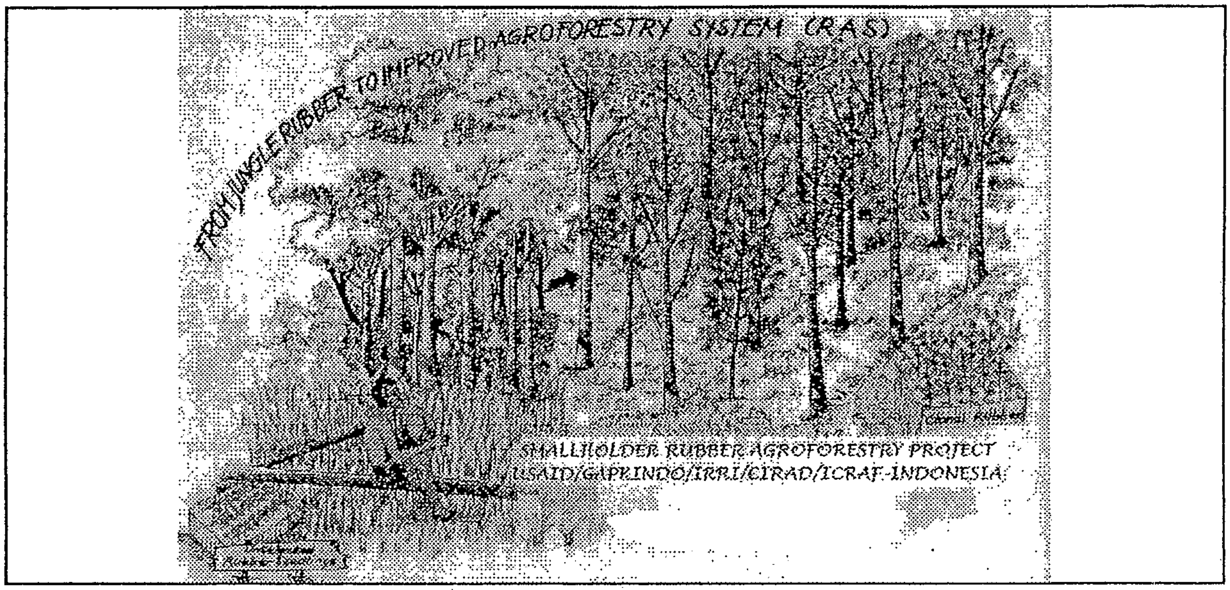
Sur le terrain, la collaboration est toujours soutenue avec les projets SFDP/GTZ de West Kalimantan et le Pro-RLK/GTZ de West Sumatra, ainsi que ASB/ICRAF pour Jambi.

ANNEX 1

PUBLICATIONS
of SRAP
a GAPKINDO/IRRI/CIRAD/ICRAF PROJECT

SMALLHODER RUBBER AGROFORESTRY PROJECT SRAP

GAPKINDO / CIRAD / IRRI / ICRAF



SRAP BIBLIOGRAPHY

November 1997

PUBLICATIONS

of SRAP

a GAPKINDO/IRRI/CIRAD/ICRAF PROJECT

1997

Penot E. *Associated trees with rubber in Rubber Agroforestry Systems (RAS).* paper presented ate the ICRAF workshop on the "domestication of agroforestry trees" Jogyakarta, 4-7 November 1997, Gadjah Madah University

Budiman A.F.S.& Penot E. *Rubber agroforestry in Indonesia.* Paper presented at the "Internartional rubber conference 1997 : Rubber science and technology : improving quality of life". RRIM, Kuala Lumpur, Malaysia. October 1997.

Penot E. *L'amélioration des agroforets à hévéa : un enjeu pour 1 millions de paysans en Indonésie.* Published in CIRAD-CP PRD publication. December 1997, Montpellier. In Press?

Penot E. *More improved complex agroforestry systems to decrease pressure on secondary forest : the case of rubber in Indonesia.* Publication presented at the CIFOR/USAID International Workshop on "management of secondary forest in Indonesia". Bogor, November 1997.

Penot E. *Introduction to SRAP methodology and concepts : summary of the preliminary results.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Penot E, Ir Sunario, Ratna Akiefnawati & Ir Hilahang. *Main agronomic results of RAS on-farm experimentation network in West Kalimantan.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Penot E *Rubber Agroforestry Systems : RAS 2 on farm experimentation in West Kalimantan : preliminary results of rice (local varieties in the first year of establishment) and in rice trials (RAS 2) planted betwen 1994 and 1997.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Penot E & G. Wibawa *Preliminary conclusion summary paper of the SRAP workshop on Rubber Agroforestry systems.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Wibawa G, E. Penot, Ratna Akiefnawati, S. Williams. *Main agronomic results of RAS on-farm experimentation network in Jambi.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry .Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Hisar Bihombing & Eric Penot. *Main agronomic results of RAS on-farm experimentation network in West Sumatra.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

W Shueller, E Penot, Ir Sunaryo. *Rubber Improved Genetic Planting Material (IGPM) availability and use by smallholders in West-Kalimantan Province.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

A. Kelfoun, E Penot & Iwan Komardiwan. *Farming system characterization and innovations adoption process in Jambi .* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Ph Courbet, E Penot & Ir Hilahang. *Farming system characterization and innovations adoption process in West-Kalimantan.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Rien Bekuma *Biodiversity in rubber agroforests.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Sandy Williams *Below-ground interactions between rubber and weeds in an immature RAS 1 type agroforestry system.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Ratna Akiefnawati & Meine van Nordwick *P fertilization in RAS 1.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Quirine M.Ketterings *Slash and burn as land clearing method for rubber smallholders in Sepunggur, Jambi province, Indonesia.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia .

Hubert de Foresta *Smallholder rubber plantations viewed through forest ecologist glasses. An exemple from South Sumatra.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Sylvia Werner *Biodiversity assessment of jungle rubber in West-Kalimantan.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Fred Stole *Land use in Jambi province in Sumatra : an overview.* Paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Gerhard Eli Sebastien *Rubber fertilization trial (RAS 1.3) in RAS 1 environent in Jambi province.* Poster paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

S Wiliams, G Wibawa & M van Noordwijk *Rubber roots shift to the subsoil when there is intercrops.* Poster paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Iwan Komardiwan & E. Penot *Rubber IGPM availability and use in the Jambi province.* Poster paper presented at the SRAP workshop on R.A.S. (Rubber Agroforestry Systems), ICRAF, 29-30th September 1997. Bogor, Indonesia

Penot E. *Compte rendu du Forum GAPKINDO 1997.* Bali, August 1997. CIRAD internal document.

Penot E. *From shifting agriculture to sustainable rubber complex agroforestry systems (jungle rubber) in Indonesia: an history of innovations production and adoption process.* Paper presented to the ICRAF/Cornell University workshop on "indigeneous strategies for intensification of shifting cultivation in Southeast Asia". June 1997.

Penot E. *From shifting agriculture to sustainable rubber complex agroforestry systems (jungle rubber) in the peneplains of Sumatra and Kalimantan in Indonesia: innovations in local rubber based cropping systems* Contribution to the CIRAD/World Bank report "Indonesia : upland agricultural technology study". Edited by F Ruf and F Lancon. CIRAD, February 1997.

Penot E. *Annual report of SRAP, 1996. ICRAF/CIRAD-CP/GAPKINDO.* CIRAD internal Report. Bogor , March 1997.

Sadahisa kato. *Smallholder rubber agroforestry in Indonesia : the effect of light availability and weeding on ground cover vegetation.* Research proposal. SRAP internal document. ICRAF.

1996

- Akieknawati Ratna, Van Nordwick Meine and Garrity Dennis. *Interaction between P nutrition and weeding frequency in the establishment of rubber agroforest with selected rubber germplam.* Initiation report. June 1996. SRP/ICRAF.

- Gauthier Remi. *Jambi field trip report on pest dammages in RAS and jungle rubber systems.* June 1996. SRAP internal document ICRAF.

Ketterings Quirine. *Effect of burning on soil organic mater and phosphorus Fractions and dynamics of soils under different rubber agroforestry systems in Jambi province.* Research proposal. 1996. SRAP internal document, ICRAF.

- Penot E. *Improving productivity in rubber based agroforestry systems (RAS) in Indonesia : a financial analysis of RAS systems.* Paper presented at the GAPKINDO

seminar in Sipirok, 27-29 March 1996, North-Sumatra.

- Penot E *Improving the productivity of smallholder rubber agroforestry systems : sustainables alternatives. Project main features in 1996.* Hand out /Working paper.

- Penot E. *Preliminary results on upland rice experimentation and monitoring in West-kalimantan in RAS 2 trials, 1994-1996.* Project paper, ICRAF, Bogor, Indonesia, 1996

- Penot E. *Sustainability through productivity improvement of Indonesian rubber based agroforestry systems.* Paper presented at the14th international symposium on sustainable farming systems. Colombo, Sri Lanka, November 1996.

- Penot E, Gede Wibawa. *Improved Rubber Agroforestry Systems in Indonesia : an alternative to low productivity of jungle rubber conserving agroforestry pratices and benefits. First results from on-farm experimentation in West-Kalimantan.* Paper presented at the IRRDB annual meeting, Beruwala, Sri Lanka, November 1996. (IRRDB = International Rubber Research and Development board)

- Penot E, Fairhurst, Sofyan, Sunario. *Rock phosphate plays a key role in the establishment of rubber based agroforestry systems in Indonesia.* Poster presented at the International conférence on nutrient management for sustainable foodcrops production in Southeast Asia, Bali, December 1996. Poster and presentation paper.

- H Bagnall-Oakeley, C Conroy, A Faiz, A Gunawan, A gouyon, E Penot et al....*Smallholder Imperata Management strategies used in rubber based farming systems.* Agroforestry systems 00 : 1-22, 1996.

- Contribution of SRAP team to *"A journey to discovery"*, ASB/ICRAF guide for ASB field trip, ICRAF, May 1996, Bogor.

- Williams Sandy. *Quarterly reports on below ground competition research programme on jungle rubber.*

1995

- Bekuma Rien. Caracterization of jungle rubber biodiversity through ferns. Research proposal. UNESCO/ICRAF.

- Penot E. *Taking the jungle out of rubber. Improving rubber in indonesian agroforestry systems.* In Agroforestry Today, July/December 1995.

- *Penot E. Rubber agroforestry systems, RAS, as sustainable alternatives to Imperata grasslands in West-Kalimantan, Indonesia.* Paper presented at the ICRAF Imperata workshop, Benjarmasin, January 1995. To be included in the collective paper "sustainable land use options on current or potential Imperata land" (supervised by H Bagnall Oakeley NRI/IRRI Sembawa).

- Penot E et Gouyon A. *Agroforêt et plantations clonales : des choix pour l'avenir.*

Présenté au séminaire CIRAD-MES, septembre 1995.

- Penot E. *Annual report of SRAP. ICRAF.* Project paper. Bogor , 1995.
Williams Sandy. *Research proposal for below ground competition in jungle rubber.*

1994

- Penot E. *The non-project rubber smallholder sector in Indonesia : rubber agroforestry systems (RAS) as a challenge for the improvement of rubber productivity, rubber based systems sustainability, biodiversity and environment.* Working paper. Presented at the 1994 ICRAF APR (Annual Programme Review). 15 septembre 1994.

- Penot E *Improving the productivity of smallholder rubber agroforestry systems : sustainables alternatives. Project frame, general proposals and On-Farm-Trial methodology*. Working paper. Presented at the 1994 ICRAF APR. 15 septembre 1994.

- AFS Budiman, E Penot, H De Foresta, Suyanto & T Tomish. *Wanatani karet terpadu untuk masa depan karet rakyat Indonesia (Rubber Agroforestry systems as alternatives for smallholder in Indonesia.* Article présenté à la Conférence nationale sur le caoutchouc, IRRI, Indonesian Rubber Research Institute, Medan, Novembre 1994. En indonésien et en anglais. Title in English "*Integrated rubber agroforestry for the future of smallholder rubber in Indonesia*".

- Penot E. *Rubber Agroforestry Systems (RAS) methodology.* ICRAF, project paper. Bogor, Indonesia, decembre 1994.

ANNEX 2

Annual report for ICRAF 1997

An ICRAF/GAPKINDO/CIRAD-CP cooperation research programme

Smallholder Rubber Agroforestry Project SRAP

ANNUAL REPORT 1997

Highlights on Rubber Agroforestry Systems experimentation and RAS farming system surveys

ICRAF (Southeast Asian Regional Programme) Programme 4 : systems improvement.

Part concerning SRAP written by :
Eric Penot for all SRAP team members

SRAP : The Smallholder Rubber Agroforestry Project.
Introduction

This research programme has been developed since 1994 in collaboration with CIRAD-CP[1] and GAPKINDO[2]. It is aimed to improve the productivity of farmers' rubber based complex agroforestry systems. The main objective of the RAS research programme is to identify the components of low cost and medium labour requirement agroforestry systems based on improved clonal rubber as an alternative between the low cost but low productivity current "jungle rubber " and rubber monoculture.

The programme is based on the 3 following major activities :

* a network of on-farm trials using participatory approach to test Rubber Agroforestry Systems (RAS) with innovations such as the use of clonal rubber planting material in forest environment (RAS1), food crop intercropping during the rubber immature period and combination of fruit and timber trees with rubber (RAS 2),and the establishment a combination of covercrops and fast growing trees (in RAS 3 on degraded land with a frame similar to that of RAS 2). The programme is implemented with 4 SRAP/ICRAF staffs in 3 provinces : West Kalimantan, Jambi and West Kalimantan in various Kind of environment : traditional forest environment, *Imperata* grasslands and piedmont with steep slopes.
* the farming systems characterization in the 3 selected provinces in order to identify a socio-agro-economical typology of situations (with 2 MsC students from France and 2 SRAP staffs).
* a budwood garden programme, to test whether clonal rubber can be produced by the farmers at low cost with a good quality (with one MsC student from France and 1 SRAP staff).

In addition to these 3 main activities are also implemented through the "Rubber Agroforestry Initiative" the following research themes :

* the study of below and above ground competition in RAS 1 system in Jambi province (with one PhD student from UK)
* The characterization of jungle rubber biodiversity though the ferns species in Jambi province (with 1 seconded ICRAF staff) .
* specific agronomic experimentation on fertilization in RAS systems and effect of slash and burn techniques on soils (with 1 PhD student from USA).

The local partners for field implementation are the following : Research Institute : IRRI/Sembawa (Rubber), Development projects : SFDP/GTZ (West-Kalimantan) and PRO-RLK/GTZ (with extension agencies in West-Sumatra). SRAP is funded by GAPKINDO, ICRAF and USAID. A workshop has been organized in September 1997 which summarized research results and preliminary recommendations.

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[1]the Tree crop division of CIRAD, France, with the rubber programme.

[2]GAPKINDO is the Rubber Association of Indonesia, a private NGO regrouping the rubber processors and the major rubber estates.

Main ACHIEVEMENTS IN 1997

The achievements have been the following :

.- 1 - the set-up of operational teams in the 3 provinces with ICRAF and IRRI scientists as well as collaborators based in the sites. SRAP has developed a base for multi-disciplinary work on various other topics such as farming system research, biodiversity study, nutrient management, below ground competition...

- 2 - the identification of the main components of a RAS (Rubber Agroforestry Systems) methodology for on-farm experimentation after 1-3 years of experience in the field (the most critical phase of establishment for RAS). A RAS manual has been produced and will be completed and multiplied in 1998.

- 3 - the completion of the on-farm trials network (100 fields) and the budwood garden network (10).

- 4 - On-farm controlled trials on P management and root competition with PhD students.

- *5* - a farming system characterization with an operational typology that allow us to identify clearly the "recommendations domains" and the type of RAS per target.

- *6* - The understanding of the constraints for self-production of clonal rubber panting material by farmers from the analysis of the farmers' communities involved in the budwood village garden.

The RAS on-farm trials network

The expected outputs of this programme in the mid-term are a complete set of technical recommendations for RAS. In the short term the main issue is to identify the conditions under which rubber can grow optimally in an agroforestry environment for the critical first 2 to 3 years, in terms of cropping patterns, type of clonal planting material, levels of weeding and fertilization and rubber/associated tree combination. Other aspects such as associated tree species combination, rice and palawija intercropping or covercrops and pulp trees/MPT combination are being tested.

The in-depth study of some particular agronomic components, such as root competition, below ground interaction and nutrient management, in particular P, should enable a better understanding of the competition dynamic and the interactions between trees, weeds, and natural vegetation regrowth (in RAS 1) as well as performances in terms of growth, competition and yield. This experimentation is well documented in SRAP province progress reports and methodology documents.

The network may be summarized in the following table :

Table 1 : FARMERS AND AGRICULTURAL SCHOOL INVOLVED IN RAS ON FARM EXPERIMENTATION

Province	Village	Nb of Trial	RAS 1.1	RAS 1.2	RAS 1.3	RAS 2.1	RAS 2.2	RAS 2.5	RAS 3	Farmer	Agricultural school
West-Kalimantan	5	15	5	1		2	3		4	63	1
Jambi	3	7	2	1	1		1	2		26	1
West-Sumatra	1	3					3			8	-
Total	9	25	7	2	1	2	7	2	4	95	2

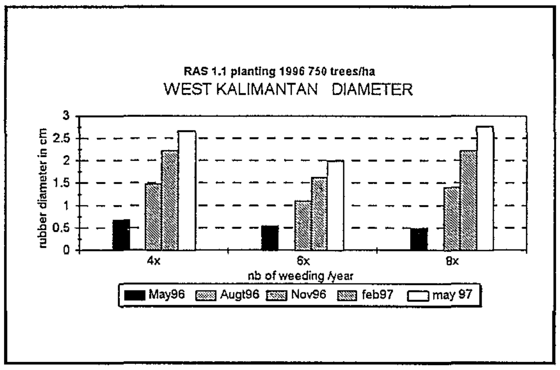
Preliminary results of RAS on-farm experimentation

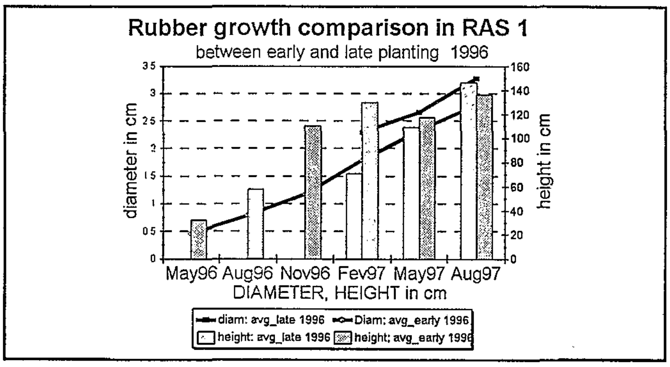
In terms of RAS establishment, the 3 main factors being evaluated are rubber planting material (clonal rubber), weeding level and fertilization amount, in particular phosphate (P) (Penot, Fairhurst and al,.1996). The most critical period for RAS establishment are the first 2 years where competition with weeds (in RAS 3) and/or secondary forest (in particular RAS 1) is the most aggressive.

The set up of the network has been done in 2 years between December 1994 and November 1996. The main criteria to define RAS performances in such various environment is rubber growth (diameter 10 cm above grafting point, as well as height and number of whorls), recorded every 3 months for the first 3 years. Rubber trees diameter appears the most reliable criterion for measurement of growth and competition. Other data collected concerns rice production (RAS 2) and associate trees survivability (RAS 2 & 3). The results have been presented in details in the SRAP workshop of September 1997.

*** Clonal rubber vs secondary forest regrowth in RAS 1 : the weeding level.***

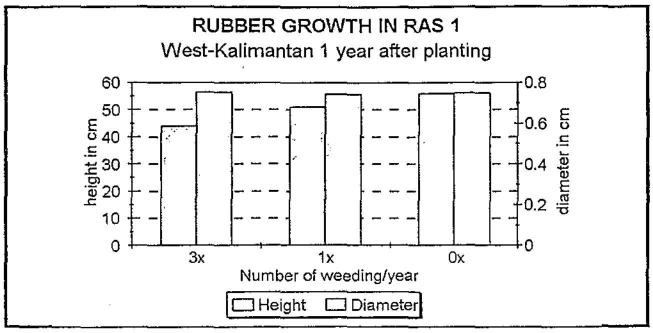
Early planting of rubber in polybag is an essential condition for all RAS establishment, in particular for RAS 1. The RAS 1 trial established in late 1996, at the beginning of the rainy season, with good quality planting material (from Goodyear North Sumatra) is as

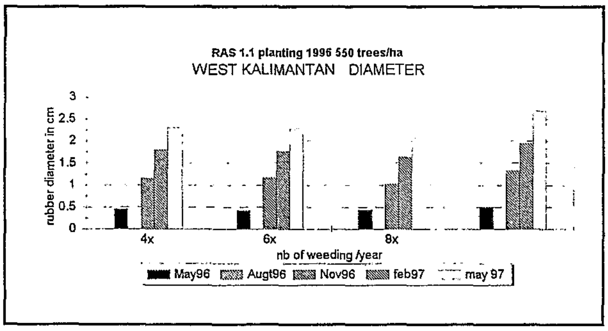




developed 7 months after planting that that of trial plantes in January/February 1996, late in the rainy season. The treatment is based on 3 weeding levels (4X, 6X and 8x per year in West Kalimantan, 3x, 6x, 9x/year in Jambi). Protocols were not always followed. In West Kalimantan, generally "4x" was 2 to 4 weedings/year, "6x" was 4 weeding/year and "8x" was 4 to 6 weeding per year. The control is 8weeding/year and LCC in the inter-row (similar to monoculture).

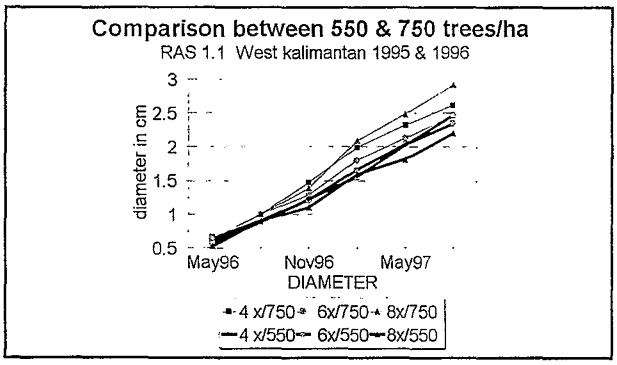
The first results show that the required weeding level during immature period in RAS 1 for clonal rubber is far higher than that of jungle rubber : from no or 1 weeding/year to 3-4 weeding/year are necessary for clonal rubber in Jambi, and 4-6 weeding/year in West-Kalimantan due to Imperata pressure for the first year (8 weedings were never actualy applied by farmers in West Kalimantan). The first RAS 1 trial planted in January/April 1995 in West Kalimantan, with 0, 1 and 3 weeding/year shows clearly that weeding level was not sufficient to overcome Imperata which systematically invaded all plots. The regular number of weeding/year is relevant in West Kalimantan because





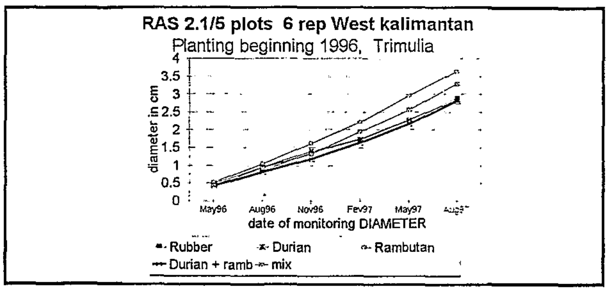
Imperata comes back regularly. In Jambi, the weeds pressure is depending on the environment (no *Imperata)*. For the second year, 2 to 4 weedings/year in Jambi and 4 weedings/year in Kalimantan are sufficient. On RAS 1.1 trial with 2 planting density (550 and 750 trees/ha), no significative differences have been observed in 2 trials with 3 replications each planted in 1995 and 1996.

The weeding/fertilization couple is a key component in the trade off between rubber growth/competition and input/labour cost, in particular where fertilization is really required (Kalimantan).

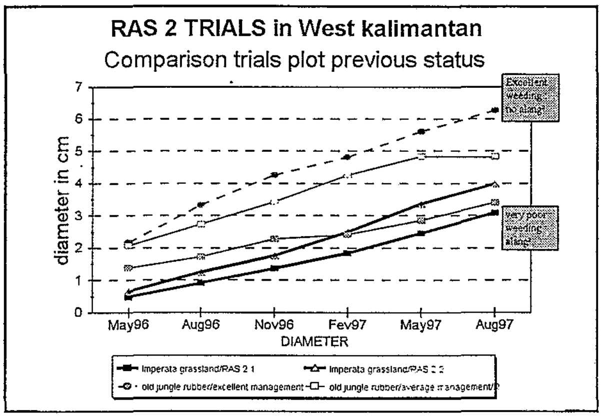


Annual intercropping in RAS 2.1 and 2.2: the most efficient alternative to favour rubber growth and optimize labour

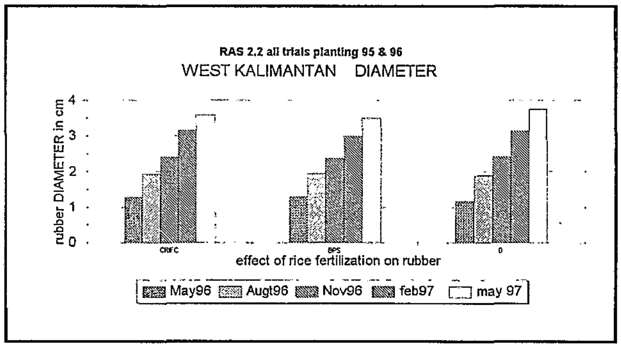
In RAS 2.1, treatments are on the type of associated trees combined with rubber. Weeding id done every 2 months (6x/year, for all RAS 2 trials). The inter-row is cropped with rice and/or palawijas.The Figure shows that there is no effect of associated trees on rubber growth during the first 2 years. The small differences being due to other local factors and in particular temporary presence of Imperata .By comparison, RAS 2.2 plots have a better growth performances close to that of a control, established with the average growth of 3 clones well maintained. High labour requirements have not been well accepted by farmers and difficulties in following weeding protocols



have been observed in particular in Jambi showing that we arrived to the extreme limit in term of labour acceptable by farmers in West-Kalimantan for RAS 1.

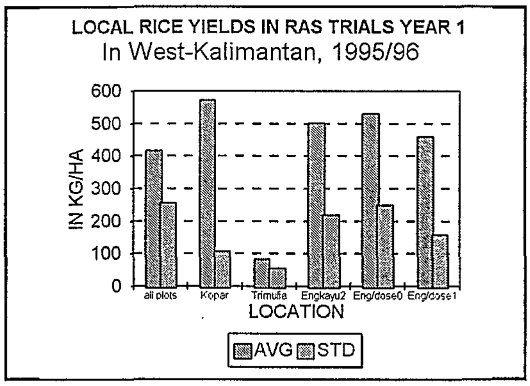


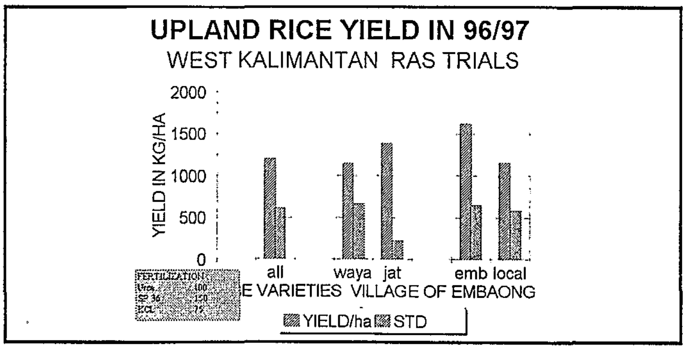
It is also clear that the land status before RAS establishement is important in terms of land fertility and amount of work for weed control. The figure shows that RAS 2 established after jungle rubber shows a better growth than that of RAS 2 in imperata grasslands, due to Imperata competition.



RAS 2.2 labour requirement is better accepted due to rice cropping. The different rice fertilization level("CRIFC" = high dosis, "BPS" = medium dosis nd 0) have no effect on rubber growth during the first 2 years.

Generally 1, sometimes 2 weedings, are implemented for rice. Glyphosate herbicide (Round up) was applied before rice planting. Growing rice with good local varieties (Embatu, Saim) or improved varieties (Jatiluhur and Wayararem) are successful with a small amount of fertilizers and crop protection against insects at least for the first and the second year, in particular after clearing an old jungle rubber. The third year of cropping is generally not possible due to canopy shade or due to soil compaction (such as in RAS 2 fields implemented

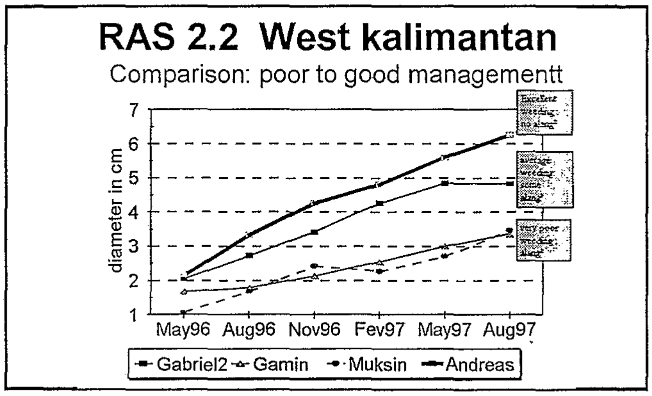




in former Imperata grassland in Kalimantan). Erratic rains, drought (like in 1994 and 1997) and delay of rain season increase risk of crop failure. Rice experimentation in RAS 2 has shown a significant effect of N-P-K fertilization (at economic level).

However yields are often too low to off-set the cost of fertilization while fertility is the first constraint in particular in former Imperata grassland, other factors for low yields are : poor

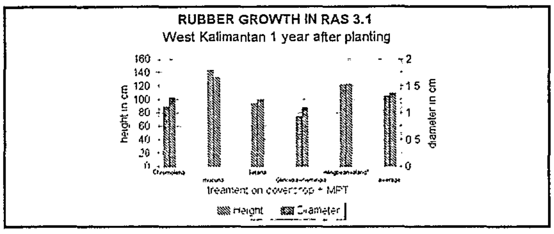
rice seed quality and availability, susceptibility of rice to insects pests and blast, and erratic rainfall at critical periods (in particular after flowering), traditional planting patterns, shading after the second year and insufficient weeding. CRIFC trial in Jambi shows that HYV upland rice yields may reach 2-3 tons/ha with a complete package using rice varieties such as Wayararem and Jatiluhur, fertilization, 3 weeding and crop protection. In Imperata grassland, zero or minimum tillage is not recommended and rice/groundnut with ploughing rotation is recommended .
In Jambi, RAS 2.2 based on palawija is very successful compared to plot that have been very poorly managed and invaded by Imperata.



In West-Sumatra, the continuous upland cropping (rice/groundnut rotation and other palawijas[3]) is very favourable for rubber growth. In West-Kalimantan the figure shows that rubber growth is significantly affected by quality and level of weeding of rice intercropping with the example of 4 farmers having cropped rice but with a different level of weeding and maintenance. However, rice fertilization does not have any significant impact on rubber growth during the first 2 years.

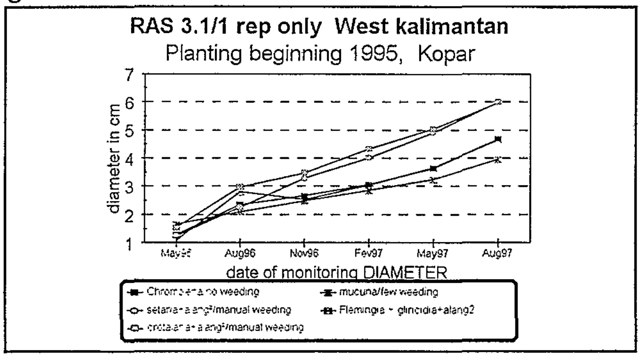
**** RAS 3 : covercrops/MPT/FGT vs Imperata at low labour cost.***

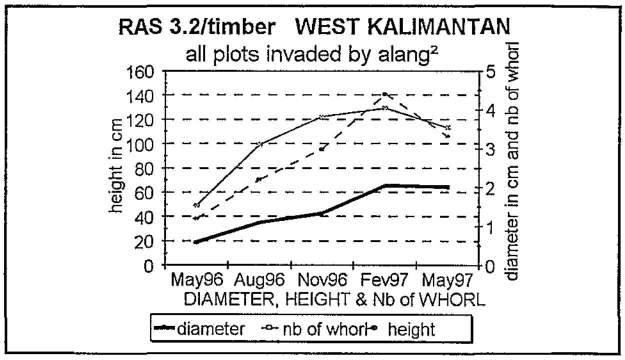
The main constraint continues to be Imperata with RAS 3.2 plots entirely invaded by Imperata. The objective is to find out what is the best combination with covercrops/MPT/FGT to overcome Imperata at a very low labour input.
The first set of treatments with various covercrops and MPT's has been entirely overcome by Imperata in 1995. Therefore, some RAS 3 trials have ben transformed into RAS 1, because natural vegetation regrowth finally overcome Imperata after 1 year showing that a failure in establishing covercrops in RAS 3 may be recovered into RAS 1 according to surrounding vegetation.
Following that first experience, a better selection of covercrops has been made on 1 "observation field" (RAS 3.1), in 1995. The best results were obtained with Mucuna and Chromolena. Preliminary observations on covercrop establishment in RAS 3 shows the following constraints : seed quality is very poor and lead to low density sprouting, generally rapidly overcome by Imperata, covercrops cannot grow without a minimum supply of P (200 kg in West-Kalimantan, though this was not necessary in Jambi), the non-viny covercrop species (selected for minimizing weeding compared to classical LCC used in plantation



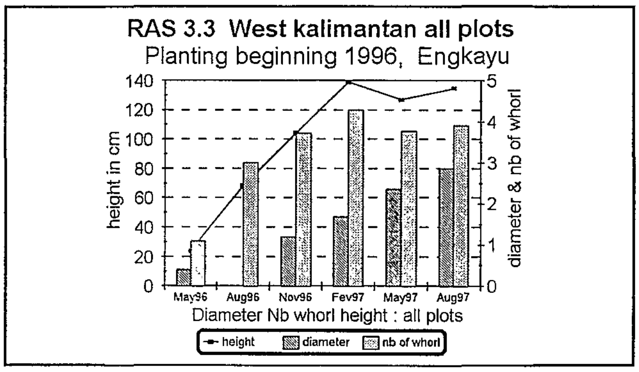
[3]Palawijas are secondary crops such as maize, cassava, vegetables, soybean, groundnut...

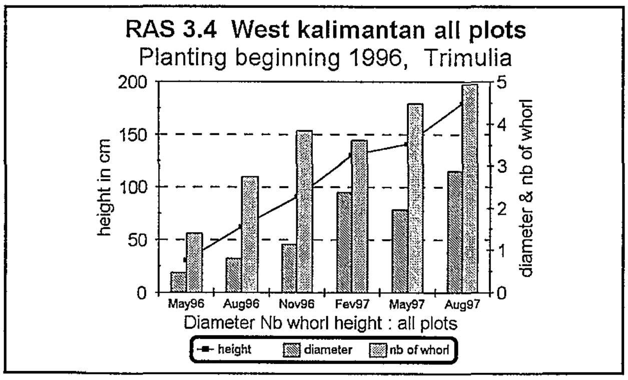
such as *Calopogonium, Centrosema pubescens or Pueraria javanica*) such as *Flemingia Congesta, Crotalaria, Chromolena Odorata, Wing bean and Mucuna* have difficulty in competing with *Imperata* in the first dry season. Shading from MPT's or pulp trees, planted in October with rubber and rice, may help to overcome , or limit *Imperata* in the dry season. A combination of covercrops and MPT's (*Gliricidia)* and fast growing pulp trees *(Gmelina arborea, Paraserianthes falcataria and Acacia mangium*) has been selected for experimentation in 1996 in RAS 3.2 (trials with various combination of covercrops and pulp trees), Rubber growth in RAS 3/2Timber (with timber trees as associated trees) is very low due to imperata that invaded entirely all plots, compared to rubber growth in RAS 3.1 with various covercrops. With Chromolena, Imperata is competely overcome and no weeding is necessary in the inter-row. The best result, with few weeding, is also reached with Mucuna. In RAS 3.2/timber, Imperata is growing faster than rubber and virtually stop the growth of rubber.



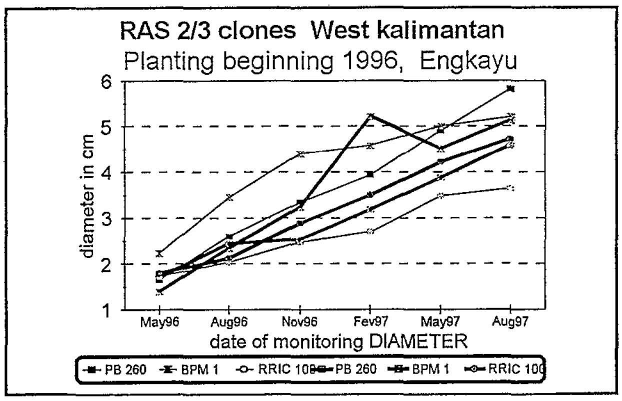


in RAS 3.3 (the selected covercrop is
Flemingia with various pulp tress and other associated fruit and timber trees) and RAS 3.4 (the covercrops is Flemingia + pulp trees at higher density with no associated trees). Preliminary results still show the difficulty of establishing covercrops in farmers conditions but pulp trees, in particular Acacia mangium were growing well and very fast, shading the inter-row, therefore limiting Imperata. It might be questionable to see if Acacia mangium will not be too competitive for rubber. No significative differences have been observed between treatment for the first 18 months, but differences are expected after 2 years, in particular with Acacia mangium and Gmelina arborea. No differences were recorded between plots in RAS 3.3 (with 100 fruit and timber associated trees/ha, similar to RAS 2 frame) and in RAS 3/4 (no associated trees , only pulp trees).





*** Rubber fertilization : P is a key component for rapid rubber growth**
The first trials in West-Kalimantan have been planted with a very low level of inputs (200 grams of Rock Phosphate per tree at planting time) which has proved far from sufficient for growth of clonal rubber in competition with the forest regrowth in RAS 1, or with Imperata in the dry season with RAS 2. A small amount of N (50 grams/tree every 3 months for the first 2 years), added to Rock Phosphate (500 KG/ha at planting time) resulted in a very good growth of GT 1 clone in Jambi and with second series of trials in Kalimantan. In West-Kalimantan, where the soils are very poor, the TCSDP fertilization programme (NPK every 3 months) has been adopted for the first 2 years only and proved to be successful. In West-Sumatra, a previous demo plot (PKT/Pro-RLK/GTZ) showed the efficacy of large amount of RP ROCK PHOSPHATE rock phosphate (1 ton/ha) at planting time for rubber growth (fig). P is definitely a major limiting factor in all sites, but N-K is also necessary in West Kalimantan and West-Sumatra, at least for the first 2 years (compared to the 5 years of rubber fertilization in TCSDP recommendations).
In conclusion *:* It is obviously necessary to provide P and N fertilization at least during the first 2 years in West Kalimatan and West Sumatra on very depleted soils, but it does not seem to be the case in Jambi.
*** Comparison between clones : the importance of good clonal recommendations**
Comparison between clones shows that BPM 1 and PB 260 have the best growth performances, followed by RRIC 100, however BPM 1 seems to be more heterogeneous.

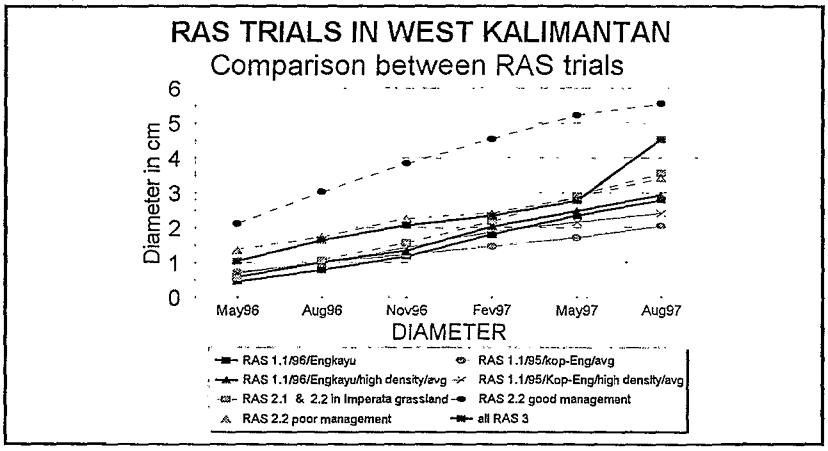


The selected clones are all high yielding, fast growing, resistant to leaf diseases (in particular *Colletotrichum*) and adapted to farmers tapping (BPM 1, PB 260, RRIC 100 and RRIM 600, introduced in 1996). In Jambi, GT 1 shows relatively good performance however Colletotrichum is rampant in that province (as well as in West-Sumatra). It is preferable to use in RAS clones that are tolerant or resistant to that leaf disease as a forest environment, the combination with other trees may increase the risk. Pigs and monkeys are the main constraints in forests margins in Jambi. Monkeys have almost destroyed trials fields in areas with low population density and poor field management (in the piedmont of the Barisan mountains in Jambi).
The above indicated the importance of establishing accurate and reliable clonal rubber recommendations based on field trial observations in various ecological zones. This lead to the planting of a RAS 1.2 type trial with the 4 selected clones (and seedlings) in order to compare their performances in an agroforestry environment. These selected clones are PB 260, RRIC 100, RRIM 600 and BPM 1.

Conclusion
In all cases, the early planting of rubber stumps with 1 whorl in polybag at the very

beginning of the rainy season in October is an absolute necessity. The direct planting of stumps has been a failure in West Sumatra due to very poor soils, steep slopes, but mainly due to erratic rainfall, and has also lead to high losses in West-Kalimantan due to poor quality of planting material supplied by a local development project (though this may reflect the quality of planting material to which farmers may have access). The stumps in polybags have already developed a root system necessary for rapid growth, in order to be sufficiently developed by the dry season (March-September in all sites) and to be able to compete with secondary forest regrowth in RAS 1 and *Imperata* in RAS 2 and 3. The availability of good quality stumps with sufficient girth is also a significant criterion. In West-Kalimantan, stumps are traditionally produced with a small diameter due to poor growth in nurseries. This highlight s the necessity to produce recommendations for building a clonal rubber planting material supply system with higher quality that may be achievable by farmers. The budwood garden programme objective is to a certain the ability of farmers to produce such high quality planting material. Another result is that if competition with weeds is important, and in particular Imperata, water is probably the main constraint in the dry season (with a possible stop in growth) as shown also in experimentation in South-Sumatra (Wibawa, 1995). Another constraint in RAS 2 is the availability of associated fruit and timber trees, the necessity for the farmers to establish their own nursery and the relatively high mortality of the trees in the field due to insufficient weeding. Labour investment is generally low (except by the Minang farmers in West Sumatra), justifying at least on a farmer's point of view the low labour approach. In West-Kalimantan, a medium level of inputs, in particular fertilization, is necessary for RAS establishment.

The use of Roundup to control Imperata is the best efficient way, both technically and economically speaking, to control weeds and Imperata as it saves numerous days or manual weeding. Manual weeding can be partly or totally replaced by chemical weeding in the rubber row.



Globally, all plots confounded per trial, RAS2.2 with good manageent (good rice cropping and 6 wedding/year on the rubber row) shows the best results, far above trees in RAS 1. But the first serie of RAS 1 trials suffers form insufficient weeding and fertilization and may not be reprsentative. Second series of RAS 1 trials shows far better results. As long as Imperata is controled, rubber growth is correct in RAS 3 but further research is necessary for RAS 3 trials as more competition is expected from some of the selected pulp trees throuh the trade -off between shading Imperata and competition to

TABLE 2

The 7 systems are the following :

- 1 - **traditional jungle rubber with unselected rubber seedlings** (actual existing system): this system has no cost other than labour in term of inputs and is very extensive.
- 2 - **Jungle rubber with clonal seedlings (GT1)** (existing system, in particular in areas close to estates, but not yet well developed) : this system uses a planting material available in all zones where estates have been established with clones. The cost of establishment is limited to the cost of the seeds or seedlings.
- 3 - **TCSDP like monoclonal rubber plot** (existing as development schemes): this system is based on the traditional project technological package developed by TCSDP[8] including clones and a high investment of weeding and maintenance,. This system requires a high level of input and labour and is ,so far, considered the 'modern and intensified' rubber cropping pattern. Costs are TCSDP estimates (TCSDP reports, DGE)), adapted with 1996 prices. In 1995, TCSDP has introduced upland rice intercropping in its technological package, so we did (for the first 3 years with improved rice and fertilization).
- 4 - **RAS 1**[9] (experimental): this is basically a jungle rubber system using clones and a minimum of inputs (TCSDP like fertilization for the first 2 years) and labour (weeding is limited on the row). The inter-row is not weeded and secondary forest is allowed to grow replacing the traditional LCC covercrops used in TCSDP system. This system is similar to the "jungle weeding" as referred by Djikman (1951) but adapted to modern clones. This is a low input/medium labour system. The challenge here in terms of research is to see if clones can compete and grow well in an agroforestry environment at a given level of inputs (basic fertilization) and labour (minimum number of weeding per year). Emphasis is put on return to labour optimization. Biodiversity is expected to be similar to that of jungle rubber. The target is the farmers in pioneer or remote areas, as well as those with limited labour resources. Biodiversity in RAS 1 is high, similar to that of jungle rubber.
- 5 - **RAS 2.2** (experimental) : rubber + associated trees + rice intercropping the first 3 years. Associated fruits and timber trees are planted at a density of 92 trees/ha. Improved or 4 months local rice (with fertilization) is grown during the immature period. The system is intensive with a medium level of input/labour requirement. Income is diversified with rubber, rice, fruit and timber production.
- 6 - **RAS 2.5** (experimental) : rubber + cinnamon : this system is specifically developed for the Jambi province where cinnamon is a recent opportunity for local farmers. A cinnamon planting density of 3 x 3 meters results in 1100 cinnamon trees/ha intercropped with rubber.
- 7 - **RAS 3.3** (experimental) : rubber + associated trees + FGT (fast growing pulp trees) : this system is designed for degraded lands where Imperata is a major risk. The first year is cropped with rice; immediately after the harvest non climbing covercrops such as Flemingia or Crotalaria are planted in order to limit the level of weeding. Associated trees and FGT are planted in the inter-row. FGT are harvested in the 5th year. This system is specifically developed for West-Kalimantan (Sanggau area) where pulpwood species can be sold to the planned pulp factory.

The main difference between RAS 1 and RAS 2/3 is that RAS 1 requires a specific environment to be set up with surrounding vegetation being forest, jungle rubber or tembawang with no Imperata. The associated trees are those which naturally growing and subsequently selected by the farmer. In RAS 2/3, associated trees are directly planted by the farmers who can choose the species among those which are adapted and are not too competitive with rubber. In RAS 2/3, tree diversity is limited to the cropped species, however farmers may select among the naturally growing species those which have an economic output.

All systems except RAS 2.5 have rice intercropping the first year.

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[8] TCSDP = Tree Crop Smallholder Development Project/World Bank

[9] All Rubber Agroforestry Systems have the following characteristics :

- rubber is planted at 550 trees/ha (6 x 3 meters). The selected clones are PB 260, RRIC 100, RRIM 600 and BPM 1.
- associated trees (if any) are fruits (local and improved rambutan) and local timber trees at 92 trees/ha (9 x 12 meters).
- FGT (Fast Growing pulp Trees) are planted at 3 x 3 in between rubber and associated trees (400 trees/ha). They are harvested the 5th year after planting.
- cinnamon is planted at 3 x 3 in the inter-row and harvested the 7th year.
- fertilization follows TCSDP recommendations for the first 2 years.

rubber.

Cost-Benefit analysis of RAS technologies compared to jungle rubber and TCSDP rubber monoculture system.

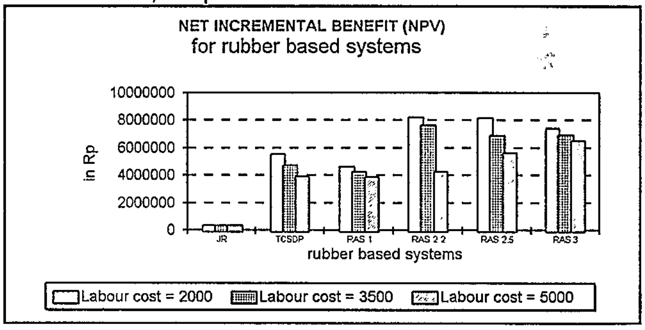
A preliminary economic analysis of 7 rubber based systems ranging from the least intensified, but the most used and traditional in Indonesia - jungle rubber - to the most intensified, RAS 2.2 with annual and perennial intercropping has been done (Penot, 1996) through the calculation of NPV (Net Present Value), incremental benefit (compared to the jungle rubber system) and return to labour over the complete lifetime (up to 35 years), the productivity per type of crop, the return to labour and the incremental net benefit for various rubber based cropping patterns compared to jungle rubber in order to compare economic rationale of RAS to other systems (jungle rubber and monoculture).
The 7 systems are described in table 2 and 3.

RAS recommendation domains

In all cases, rubber is the main economic driving force of each system. Income diversification enable farmers to profit from market opportunities for fruits, timber, rattan and other non-timber products. RAS 1 and RAS 2.5 are designed for farmers in remote or pioneer areas with low cash availability and without land shortage. RAS 2.5 is targeted especially for piedmont zones close to the Barisan mountains in Sumatra. RAS 2.2 is the most intensive system aimed at farmers with severe land limitation such as transmigrants. Farmers in degraded areas with Imperata (in West-Kalimantan for instance where the risk is high) are targeted for RAS 3.

The economic rationale of RAS technology.

The incremental benefit of RAS systems is in the same range as that of TCSDP for RAS 1 and significantly superior for RAS 2.2, 2.5 and 3 due to the non-rubber components production such as fruits, cinnamon or pulp trees production. The most intensive systems, TCSDP and RAS 2.2 are very sensitive to labour cost, in particular for RAS 2.2.



RAS incremental benefit is far higher than that of jungle rubber, even using clonal seedlings, mainly due to the fact that the total income comes from rubber and rubber productivity with clones is multiplied by 3, in addition to other sources of income. Incremental benefit is still very attracting at high labour cost, but then systems are in the same range. RAS systems are aimed to decrease labour requirement and gives a very interesting output in the case of low opportunity cost, which is generally the case in most rubber producing areas except South and North-Sumatra provinces.

TABLE 3

Economic analysis of rubber based cropping systems : characteristics of calculation.

In this first financial analysis, there is no depreciation of initial investment during the immature period. It is assumed that farmers do not use credit in order to simplify the assessment of rubber systems performances. To provide a criteria of comparison for this initial investment, we present the number of days of work at local opportunity cost (generally in a estate nearby for a daily wage of 3 500 rp[10], that is the case in West-Kalimantan) that are required to cover costs of investment. A further analysis should include a credit scheme. A credit scheme will not significantly change the long term financial analysis. Costs and benefits are calculated in net present value (NPV) with value at the end of the period (1 year) with a rate of interest at 15 %, equivalent to the current real interest rate in Indonesia (table 1). The total net benefit includes that of rubber, rice, fruits, cinnamon and timber for the overall lifetime of each system, voluntary limited to 35 years (possibly more). RAS 2.2 and 3 systems with associated trees may also evolve, beyond the rubber lifespan, into fruit and timber based agroforestry systems. Rubber wood from seedlings is counted only as fuelwood with a limited value but may be sold later as a valuable product (for particle board or pulp for instance). Clonal rubber wood is expected to be sold as a valuable timber product in particular for furniture industry. In all case, rubber wood harvest is contracted.

Costs are effective costs observed in current on-farm experimentation of SRAP. Prices are those observed in February 1996. Production and labour requirements are assumptions based on previous surveys (Gouyon, Barlow....) or farmers interviews.

The analysis is based on the situation in West-Kalimantan with no fencing cost (except for RAS 2.5 system, based on rubber and cinnamon in Jambi only). In RAS 2.2 and 3, timber trees are harvested 35 years after planting yielding a modest benefit. Fruit production is annual for petai and jengkol and durian, duku and rambutan are assumed to fruit every 3 years. We also assume that yields are low and only 50 % of the production is actually sold for which gives us 40 producing trees/ha. Distribution between trees is the following : fruit trees : 75 % (70 trees/ha with 60 producing trees) and timber trees : 25 % (22 trees/ha).

Labour for tapping is limited in RAS systems to 120 tapping days (1 tapping day is 0,5 manday) as PB 260 and other selected clones allow a D/3 tapping system (tapping every 3 days) without any decrease in production. Jungle rubber is tapped more frequently (200 tapping/year so 130 man days including other activities). Labour is converted into total man days in our calculation. It is assumed that rubber is tapped by the owner.

Production patterns have been carefully adjusted to account for the normal evolution of production including losses of trees. In RAS 1, 2.2 and 3 ; rubber yield has been slightly reduced (10 %) due to possible competition with associated trees compared to that of a TCSDP monoclonal rubber plot (this is an assumption). RAS 2.5 rubber production is assumed to be similar to that of TCSDP as cinnamon is harvested the 8th year with no further competition. Production and prices for fruit and cinnamon have been assessed from interviews with farmers and ENSO/West-Kalimantan for pulp trees production. TCSDP system may be adopted by farmers on their own or though projects. A line in table 2 shows the actual cost of TCSDP system in project, including project costs (evaluated at 1,5 millions rp in 5 years).

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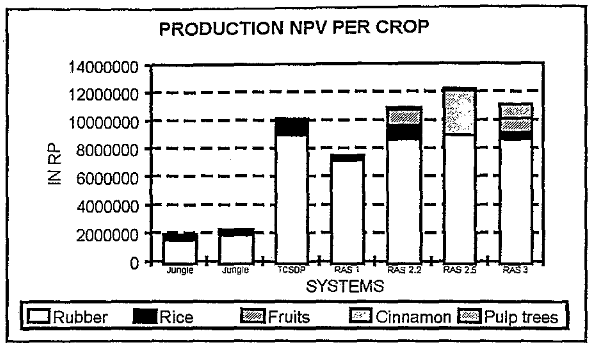
[10]However official minimum daily wage is 4600 rp in March 1996 in Indonesia, the daily wage observed in West-Kalimantan and Jambi provinces is generally close to 3500 rp.

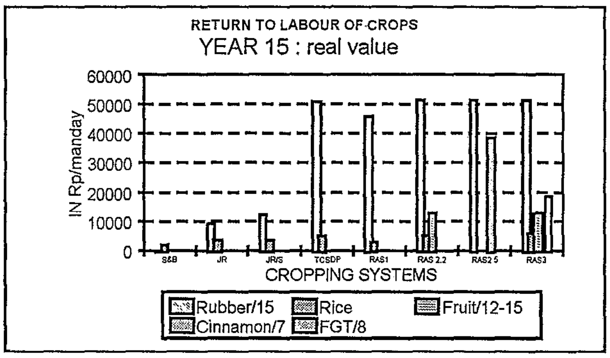
Table shows that rubber contributes to around 80 % of total income and to 95 % in RAS 1, but the use of Net Present Value of production increase the importance of rice during the immature period and decrease the final value of the wood at the end of lifetime. In fact, clonal rubber wood and timber output is expected to be high enough to able the farmer to further invest in whatever improved cropping system (monospecific plantation of rubber or oil palm or agroforestry systems). Jungle rubber produces not only rubber but also fruits, timber for local use, medicinal plants, rattan and firewood which are generally for self-consumption. Production for self-consumption is not taken into account in this calculation, but is considered as a general benefit for the farmer that is comparable for all systems except TCSDP[4] which is monoculture.

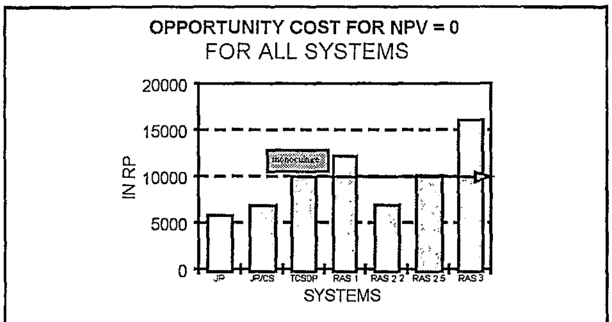


The return to labour : a sensitive argument for farmers in selecting a cropping system.

The evolution from an input extensive system such as jungle rubber into an intensive system such as RAS 2.2 or TCSDP is generally limited by cash availability and labour. Two conditions must prevail for adoption of new technology : limited risks and high return to labour, or at least conservation of return to labour comparable than that of a jungle rubber.

Figure shows rubber return to labour is definitely improved with TCSDP and RAS (around 50 000 RP rock phosphate/man day compared to 9 000 RP rock phosphate for jungle rubber at the year 15 in full potential production). A better estimation of the return to labour in the long term may be done using the labour cost that leads to Net Present Value equal to zero (fig).



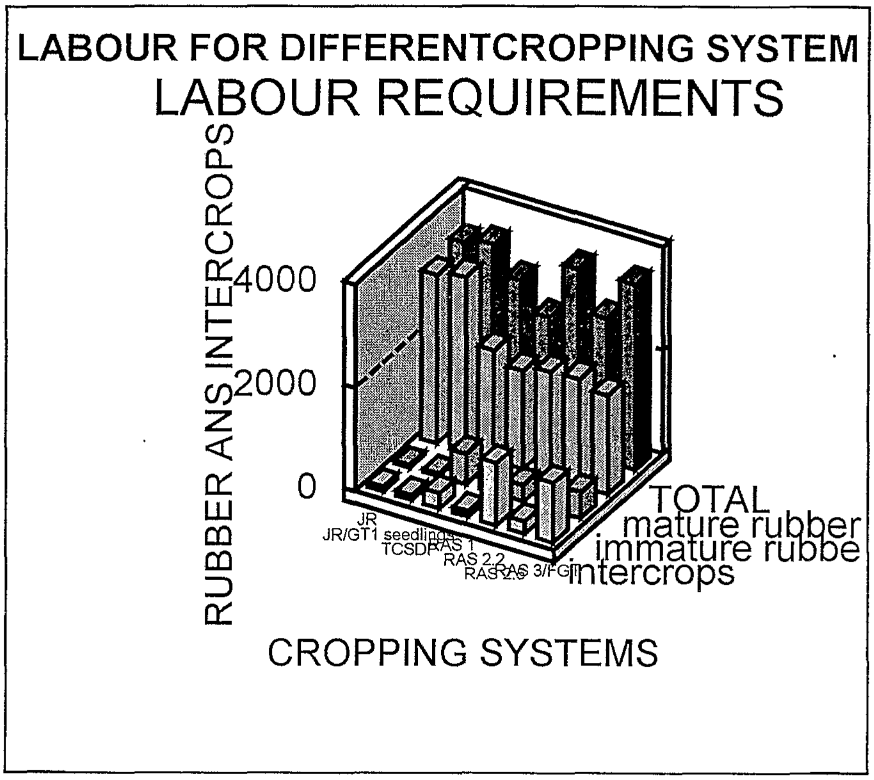


The interest of these intermediate systems is that they are still affordable for farmers (investment cost is limited) with limited labour

[4] TCSDP like monoclonal rubber plot is the only system without non-rubber products but it is also not an agroforestry system.

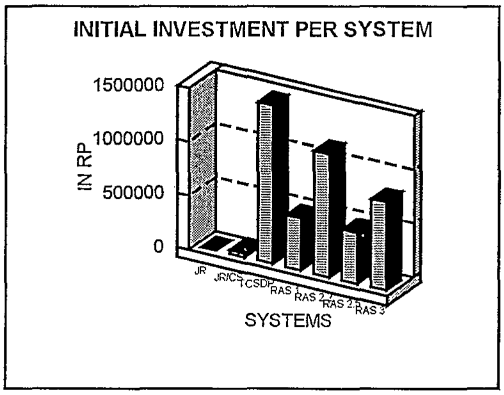
requirement and a good optimization of labour. RAS 1 is typical of that situation. A possible constraint is the distribution of required labour, in particular during the immature period. TCSDP and RAS require labour prior to production systems (respectively 300 to 500 man days for RAS and 600 for TCSDP) in contrasting with jungle rubber (54 man days). In RAS, labour required during immature period is less than TCSDP. The main constraint for adoption of a clonal rubber based system is the necessary minimum level of maintenance during the immature period.

The first 2 years are critical as rubber clones require a minimum level of weeding (3 to 6 weeding/year compared to 12/year for monoculture). Labour requirement in RAS systems is 50 to 75 % that of TCSDP monoculture system leading to a better adoption of clones by farmers as far as labour during immature period is concerned (table).



After opening, the low tapping frequency of clones leads to a significantly improved return to labour. For these reasons, the use of clonal seedlings do not yield a real significant impact on return to labour as well as income. Exploitation system and tapping frequency are key issues in improving return to labour during production period.

Return to labour is optimized in the RAS 1 system. RAS 1 is aimed to decrease the labour requirements by 30 % during immature period (table 7). For RAS 2.2, rice intercropping has significant benefits for rubber growth however rice production does not have a great economic value compared to that of rubber. Nevertheless, it is important for some farmers to grow rice during the immature period in order to valorize labour investment, in particular for those with limited access to land such as transmigrants.



For RAS 2.5, cinnamon is definitely a very interesting associated crop with rubber as it fits well with the strategy of local farmers in the Muara

Bungo area (Jambi). This extensive system fits also local farmers' strategies focused on low labour investment. For RAS 3, pulp trees are an important source of additional income. This may help the farmer to reimburse credit.

Initial investment is also an important component of

TABLE 5 : SITES CHARACTERIZATION

factors	*West-Kalimantan Forest margins with poor soils and transmigration areas.*	*Jambi (Sumatra) Forest margins*	*West-Sumatra Very degradedd land*
type of population	*a) Dayak (Christians) b) Javanese transmigrant (Muslim)*	*Malayu (Muslim)*	*Minang (Muslim)*
population density	*a) low with plenty of land b) high with limited land (2 ha)*	*low with plenty of land*	*low with limited land (marginal lands)*
ecological environment	*a) 2nd forest, jungle rubber and tembawang (*1), poor soils. b)degraded sheet imperata land, poor soils*	*a) forest and jungle rubber on steep slopes (foothill of the barisan mountains b) forest and jungle rubber on flat areas (peneplains)*	*Imperata infested land with steep slopes, poor soils, erosion and maximum altitude for rubber (500/600 meters*
farmers' behavior and strategies	*a) extensive systems, S&B for local upland rice, willing to accept a low level of intensification b) intensive with sawah and rubber on uplands. Not willing to accept intensification on upland*	*a) extensive, no upland rice, S&B for cinnamon planting Reluctant to accept labour intensification b) extensive, S&B for rice and palawija production Willing to accept a certain level of intensification*	*very intensive with continuous food intercropping on tree based systems (rubber) Very keen to intensify*
Main constraints	*a) low productivity of jungle rubber, Imperata b) very degraded land with imperata on a very limited cropping area (2 ha) High pressure of Colletotrichum (rubber leaf disease)*	*a) low productivity of jungle rubber, vertebrate pests on new rubber plantations, b) low productivity of jungle rubber Mikenia Pigs and Monkeys*	*no sustainable continuous foodcrops systems, Imperata, erosion on very steep slope, erratic rainfall, Remote area, Altitude : maximum for rubber. Rubber leaf disease Low availability of inputs. Pigs depredation*
opportunities	*a) available land Presence of SRDP/TCSDP *3 Existing old complex agroforestry practices b) farmers motivated*	*land available Existing old complex agroforestry practices very good access to markets*	*very good motivation for intensification*
On Farm trials priority	*a) RAS 1 and RAS 2 b) RAS 2 and RAS 3*	*RAS 1 RAS 2*	*RAS 2*

**1= Tembawang are indigenous fruit and timber based complex agroforestry systems where the main tree maybe Illipe nut tree.*

**2 Imperata and Mikenia are majors weeds which limit growth of crops.*

**3 SRDP and TCSDP are rubber development projects funded by WB based on clonal rubber monoculture.*

farmers strategies. RAS systems are low to medium inputs systems. Table 7 shows the importance of initial investment in NPV related to that of TCSDP with respectively 30 %, 55 % and 78 % for RAS 1 and 2.5, RAS 3 and RAS 2.2 of that of TCSDP (if adopted by farmers on their own without projects cost). If we had the TCSDP project cost, estimated at 1.5 millions RP rock phosphate/ha, then it is clear that RAS technology is more affordable for farmers and constitute a very interesting alternative to the current rubber development policy.

Farmers typology of situations.

Three provinces have been selected In Indonesia to cover a wide range of conditions in terms of ecological and socio-cultural and economic factors under which farmers have developed a range of strategies for innovation adoption and cropping pattern intensification. All sites are located in equatorial climate, with rainfall between 2000 and 3 000 mm/year, suitable for rubber production which is the main driving force of RAS systems. Soils are yellow/red podzolic soils , very acid, with a low fertility status (low content of nutrients and high toxicity to aluminum), in particular in West-Sumatra and West-Kalimantan. As continuous annual foodcrop patterns are not possible on such acid soils (however some transmigration schemes have been based on the contrary assumption in particular in West-Kalimantan which led to failure), farmers oriented their strategies on tree crops among them rubber and oil palm are the main cash crop which are complemented by timber, fruits and NTFP (Non Timber Forest products).

Various populations with different behavior related to forest environment, cropping strategies and resources allocation are taken into account in order to cover a wide range of socio-economic situations. Table gives a summary of these different situations in the 3 selected provinces. Table shows some selected constraints and opportunities of the 3 benchmark areas directly related to farmers strategies and RAS technologies (table 4) .This typology takes into account the socio-economic environment (remoteness, pioneer zones, access to credit, inputs, information....) and the ethnic factor (Dayak, Malayu, Javanese and Minang) which is essential to understand the farmers strategies. The establishment of on farm experimentation has been done with preliminary selection of representative zones with various constraints, both technical or environmental (Forest vs Imperata grasslands) and socio-economical (including ethnic groups).

The village budwood garden programme

After 1 year of experimentation with RAS in selected villages, discussions with farmers showed their interest in producing themselves clonal rubber planting material which represent more than 50 % of the total cost of establishment for RAS (see economical analysis of RAS, E Penot, 1996). Preliminary information has been provided on clones, grafting, nursery and budwood garden techniques to farmers who show motivation for production. The main constraint for farmers is the budwood availability and quality (clonal purity) as well as technical information and training on grafting in order to acquire the technical skill. The main idea was to provide to farmers the external components (innovations) that are out of reach for them without an external aid : basically budwood

TABLE 6 : SRAP benchmark areas characteristics: farmers strategies.

Site Population	Main constraints	RAS type	Innovations adoption rank	strate-gies	opportunities	Sensibility to biodi-versity	Sensibility soil conser-vation	RAS adoption constrai-nts	Presence of exist-ing project
JAMBI									
Malayu forest buffer zone	monkeys pigs steep slopes	1 2.5	+ +/-	ext ext	timber NTFP cinnamon	-	-	access to clones Mikenia	reforestation project
Malayu jungle rubber peneplain	pigs monkeys	1 2.2	+ ++	ext semi	NTFP palawija	+	-	low upland rice potential	
WEST KALIMANTAN									
Dayak forest	low soil fertility	1 2.2 3	+++ ++ +	ext semi ext	timber NTFP fruits Illipe nut rattan	+++	-	access to clones	SRDP TCSDP
Dayak transmigration	very low soil fertility Imperata	2.2	+++	int	off farm work in estate	+++	++	Land scarcity	PKR-GK
Javanese transmigration	very low soil fertility Imperata	2.2 3	+	ext	off farm work in estate	-	-	land scarcity access to clones	TRANS
WEST SUMATRA									
Minang	very low soil fertility Imperata steep slopes erosion	2.2	+++	int		-	++	access to clones	Pro-RLK GTZ

gardens and training. All other components are provided by farmers themselves.
Table 4 shows he village budwood garden (VBG) programme :

provinces	community VBG	private BG	BG in schools or projects
West-Kalimantan	7		2
Jambi	0	2	1
West-Sumatra			1
Total	7	2	4

In West Kalimantan, the majority of farmers wish to have community based village budwood gardens. In Jambi, in front of a lower interest and apparent motivation, private budwood gardens have been developed in 2 villages.
The study of the implementation and use of budwood gardens in 1997 and planting material production has been done by W Shueller (french MsC student) and Sunario in West-Kalimantan and by Iwan Komardiwan and E Penot in Jambi and West Sumatra.

Summary of the main results on the "IGPM availability and use by smallholders in West Kalimantan" surveys

Between June and September 1997 three surveys were conducted in the West Kalimantan Province by W. Schueller (ENITA/SRAP student and Ir Sunaryo (SRAP[5]). The aim was to identify the technical and socio economical constraints faced by farmers concerning IGPM[6] availability and its use in rubber cropping patterns.
The first survey addresses the technical constraints linked to the IGPM production in private nurseries in the Sanggau area.

Survey I - IGPM availability in private nurseries of the Sanggau area

From producers to users (farmers), through official institutions (in particular Disbun), it seems that there is an obvious insufficient care and attention given to quality of planting material and clonal purity of the rubber planting material. Farmers have developed IGPM production activity to have additional sources of incomes beside other farming activities. However, most of them still ignore the quality requirements for such a production. Clones are mixed in the nurseries during the grafting period and there is no guarantee for the final user of the type of clone which is provided. There is no control and no certification of IGPM by such private nurseries either for governmental sources. Productivity often prevails over clonal purity. Most of the planting material is then bought by Disbun and provided to farmers through official projects.

The second one addresses the social and technical constraints faced by farmers who produce their own planting material through budwood garden village programme.

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[5] SRAP = Smallholder Rubber Agroforestry Project
[6] IGPM = Improved Genetic Planting Material

Survey II - Constraints for IGPM self-production by farmers' group through the SRAP community budwood gardens programme in the area of Sanggau-Sintang
The objective of this survey is to understand the constraints that prevent farmers to produce themselves their own IGPM at low cost with a high quality. The survey shows the importance of social balance between groups within a village, social equity, development sustainability and social agreements within the community in the process of adoption of IGPM self-production. The strong social climax and cohesion of the farmers group was a key factor in IGPM self-production. In the case of the 2 javanese villages, Sukamulia and Trimulia, IGPM production is aimed for trade and not for plantation establishment. We see here the beginning of a process of specialization (nursery activity) and it shows that the same activity, IGPM production may lead to 2 different strategies : self-production for further planting or specialization in nursery for trade.
In traditional Dayak villages, the success of the village budwood garden programme is not depending on technical constraints nor on economic, but on the community social cohesion, in particular on equity, balance and agreements between farmers groups and consensus on development strategy at the village level.

The third survey deals with the use of IGPM, particularly through the evolution of the SRDP-TCSDP[7] monoculture plots in the village selected of Sanjan.
Survey III - Evolution of SRDP-TCSDP plots in Sanjan : the re-introduction of associated trees with clonal rubber in former monoculture plots.
This survey shows that farmers still developed innovations after being forced to follow a specific technical package (monoculture). In the Sanjan village, farmers were provided with clonal rubber plantations through the SRDP-TCSDP project. Many of these monoculture plots have been transformed by planting associated trees despite official institutions advice forbidding it. They still consider monoculture as the best system for clonal rubber, but also think it does not fit their particular conditions, and that monoculture should be reserved for estates only. Indeed, farmers need other sources of income and look for diversification. Almost all the farmers still have experience with jungle rubber, and are familiar with this complex agroforestry system. They still think agroforestry practices fits their farming policy, and would like to develop a similar system in their clonal rubber plantations, although on a smaller scale. Therefore, 1/3 of them have planted fruit and timber trees or allowed regenerated trees from vegetation, with various planting density from 90 to 300 associated trees/ha beside 500 rubber trees/ha.

Farming system characterization In Jambi and West-Kalimantan
Four type of surveys have been conducted in the area of Sanggau and Sintang in West Kalimantan aswell as in the area of Muara Bungo in Jambi:
* farming systems characterization (FSS),

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[7] SRDP = Smallholder Rubber Development Project (Wold Bank scheme from 1980 to 1990)
TCSDP = Tree Crop Smallholder Development Project (from 1990 to 1998)

TABLE 7 : particular constraints for RAS adoption

topic	West Kalimantan	Jambi	West Sumatra
previous project access to information	SRDP/TCSDP	-	Pro-RLK
indigenous knowledge and agroforestry practices	+++	+++	-
clone availability	+	+/-	-
BLIG availability	-	-	+++
fertilizer use	+	-	-
upland rice HYV availability	-	-	-
seed quality	-	-	-
covercrop seed availability	-	-	-
pests and diseases		monkeys, pigs	pigs
weeds	Imperata	Mikenia	Imperata
rubber diseases	*Colletotrichum*		may be *Colletotrichum* altitude : 550 m : limit to marginal land for rubber
land constraints	very low fertility scarcity in transmigration	slope	very low fertility and slope
upland rice production	with selected local l rice average potentiality	:may be good in peneplains	excellent weeding requires land conservation techniques
RAS adoptability potential			
RAS 1	+++	+++	0
RAS 2.2/RICE	++	+	+++
RAS 2.5/cinnamon	0	0	++
RAS 3	+++	0	+

* RAS innovations adoption process,
* IGPM use and production
* innovations of rubber cropping systems and cultural practices.

The preliminary outputs are the characterization of the farming systems based on rubber, and the analysis of the constraints and opportunities for farmers to adopt rubber improved planting material in agroforestry systems, as an alternative to their rubber cropping systems (jungle rubber, monoculture). The main factor which influences farmer's strategies for land use is the social dynamic in each village. The identification of a first operational typology is based on the following criteria :ethnic group; total cultivated area, access to land, traditional land use system, access to capital , access to projects and off farm opportunities. Characteristics of study areas, farmers strategies and innovations sadoption constraints are summarized in the Table 5, 6 and 7.

Conclusion

Innovations adoption process can be considered as a social process. Farmer organization and social coherence within the village community is a key factor which enable farmers or not to integrate some innovations.

Land scarcity leads to intensification of rubber systems (first with the use of IGPM at the condition that capital is available). Therefore, good quality IGPM at low cost through self production by farmer groups seems to be a priority.

Clonal rubber adoption in the Jambi province is a technical problem (lack of grafting training although there is a real desire to learn from most of the farmers) but also basically suffers from economical problems, especially the lack of capital necessary to buy IGPM and required inputs.

Specific studies

Agronomic in-depth studies on burning effect and above and below ground competition as well as land use studies and an assessment of biodiversity through ferns have been implemented.

Conclusion

Very promising results have been obtained with RAS experimentation both on technical point of view, however sometimes data are not al all easy to process to a large variability, and on the social point of view of innovations adoption. Information on RAS 1 and 2 may be exploited for releasing technical recommendations for the establishment phase in the very next future, however some hypotheses, such as "no effect of associated trees on rubber yields (at planting density selected for current RAS)" still need to be confirmed within the next 20 years. RAS experimentation is a long term research.

The farming system characterization and the RAS innovation adoption process study implemented in 1997 will lead after complete analysis to an operational typology of situations (in 1998) where farmers will be targeted for specific RAS system according to their resources and strategies. We hope that this operational typology might be a useful tool for development agencies.

The survey on "IGPM availability and use in rubber based cropping systems" has provide useful information on farmers' strategies about understanding and indigenous knowledge about IGPM, about self-production of IGPM by farmers and about the use of IGPM in agroforestry systems, or how agroforestry practices have been integrated again to former rubber monoculture systems (with associated trees).

Specific studies enable us to have a better in-depth agronomic knowledge on RAS components. Another important component that has not been yet covered is biodiversity evolution in RAS systems, in particular in RAS 1 and comparison with existing biodiversity in jungle rubber (H. de Foresta, 1990).

ANNEX 3

WORKSHOP SRAP

SRAP Workshop on

Rubber Agroforesty System in Indonesia

Information on Workshop
and
Guidelines for Authors of Paper Contributions

29 – 30 September 97
Bogor, INDONESIA

Prepared by Eric Penot and Anita R. Jenie

Associated scientist / Workshop Coordinator
ICRAF Southeast Asian Regional Research Programme,
Jl. Gunung Batu No. 5, P.O. Box 161 Bogor 16001
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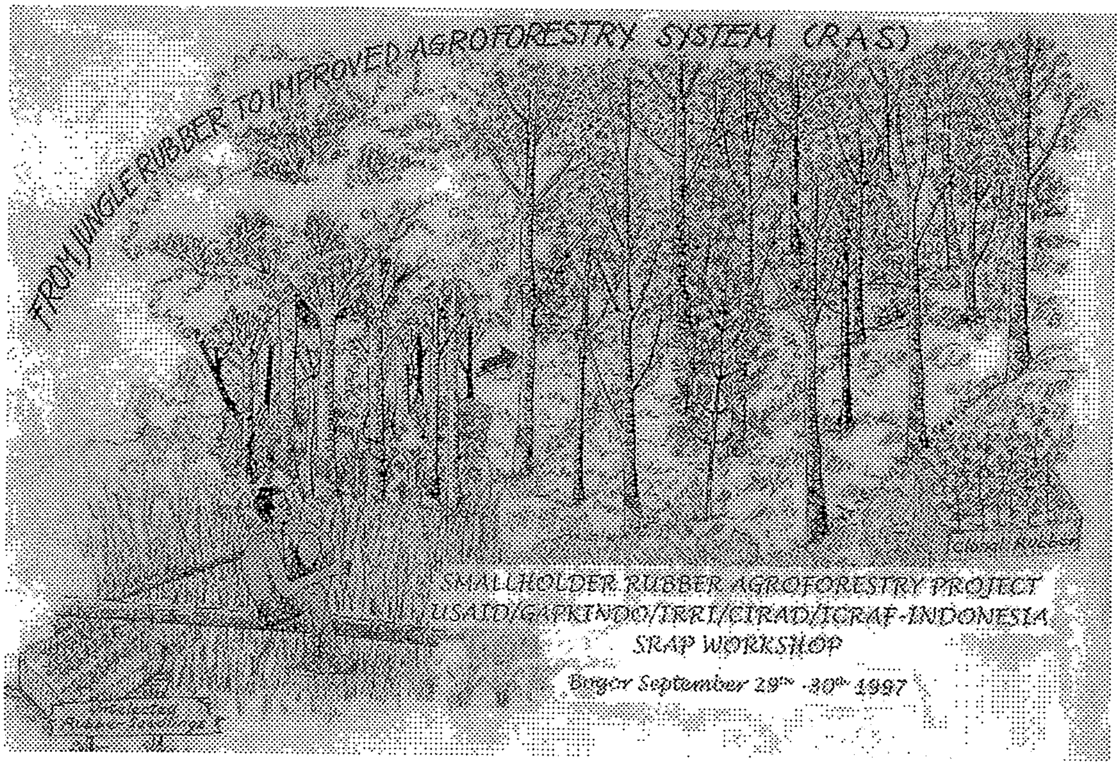
SRAP Workshop on

Rubber Agroforesty System in Indonesia



SRAP WORKSHOP ORGANIZED BY ERIC PENOT AND GEDE WIBAWA

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draft 1

TITLE OF THE WORKSHOP

RUBBER AGROFORESTRY SYSTEMS (RAS) IN INDONESIA.

SRAP workshop in Bogor, 29th - 30th of September

WORKSHOP THEME

As you know, SRAP will be already 3 years old in September 1997. It is time to assess the achievements of the project, to present our findings and results about RAS (Rubber Agroforestry Systems) technology (through the on farm experimentation network) and to identify the next steps, the next research priorities to be developed in the very next future.
The objectives of the seminar are twofold :

- to present the current knowledge, state of the art and outputs of RAS technology to a restricted assembly, in order to obtain feedback and inputs from the scientific community interested in agroforestry (first day with the presentation)
- to define the research priorities for the next future (second day with the work groups) and inputs from scientist from various institutes.

WORKSHOP ORGANIZATION

All papers are presented by SRAP and ICRAF scientists on rubber based agroforestry systems. No external papers from other institutions will be presented however we do appreciate if you can come with some of your relevant publications that can be presented on display for information. The contribution of partners and other invited institutions will being informed of the latest up to date findings of the SRAP, to contribute to a constructive critic and assessment of these outputs.

The SRAP workshop is open to any institutions or persons developing an interest in rubber based agroforestry systems. Look at the list of invited guests and suggest anyone if you think that he can contribute to the workshop success. Feel free to come if you are interested by the subject, we only request that you confirm to us your participation to the workshop in order to organize it more efficiently. Relevant existing SRAP papers can be distributed to participants before the Workshop on request.

The SRAP workshop will be continued with an internal SRAP seminar with SRAP staff only in order to review together the workshop outputs, in terms of recommendations for further research activities and also in terms of papers to be published later.

The workshop will be divide into 2 parts :

FIRST DAY :
presentation of SRAP results as well as outputs from scientists involved in the Rubber Agroforestry Initiative.

Presentations and papers will be on the following topics ;

- the main agronomic results of on farm experimentation network in West Kalimantan, Jambi and West-Sumatra.
- the budwood garden programme and the rubber planting material policy.
- farming system characterization and innovations adaption study.
- biodiversity study in jungle rubber
- agronomic in depth research findings : root competition in RAS 1 outputs and fertilization in RAS 1, and effect of Burning and Soil Fertility.

SECOND DAY : the participants are divided into 3 groups to provide comments and contribute to evaluation of the project findings and define further research recommendations.

Participants will be divided in the 4 main working groups :

- GROUP 1
  Lead : Dr. Gede Wibawa, Eric Penot, Dr. Dennis Garrity
  Sub-group 1: RAS agronomy: Dr. Gede Wibawa, Dr. Dennis Garrity
  Sub-group 2: Root Competition : Dr. Meine van Noordwijk
  Sub-group 3: RAS Modelling and GIS/regional level and use evolution: Dr. Gregoire Vincent, Fred Stolle, Dr. Gede Wibawa

- GROUP 2
  Lead : Eric Penot, Dr. Thomas Tomich, Dr. AFS. Budiman
  Associated ICRAF scientist : Dr. Chip Fay, Ir. Suyanto MSc.
  Topic : Policy issues : planting material, development procedures; innovations adoption constraints, institutional constraints (land and tree tenure)

- GROUP 3
  Lead : Rien Beukeuma, Dr. Hubert de Foresta
  Associated ICRAF scientist : Dr. G. Michon
  Topic : Biodiversity conservation and evolution in RAS.

Please, feel free to react to this first proposal.

The complete programme is available in appendix .

We would appreciate to have your full involvement and participation for these 2 full days as far as possible.

The papers, posters and outputs will be later published in the "SRAP Workshop proceedings".
Participation to the workshop is free.
Transportation, accommodation and food (except lunches) are at the charge of guests except SRAP staff.

SRAP list staff from outer islands, (costs covered by the project)
West Kalimantan : Ir. Ilahang, Ir. Sunaryo, Ir. Asngari, Sujono, Phillipe Courbet
Jambi : Ir. Ratna A., MSc., Ir. Iwan K., Ir. Gerhard S., Sandy Williams, Alexandra Kelfoun
IRRI/BPS : Dr. Chairil Anwar (Guest), Dr. Gede Wibawa, Dr. Hisar Sihombing
West Sumatra : Sofyan (Guest).
Total : 14 persons

LIST OF PERSONS AND INSTITUTIONS INVITED TO THE SRAP WORKSHOP

ICRAF
Dr. Dennis P. Garrity
Dr. Thomas P. Tomich
Dr. Meine van Noordwijk
Dr. Hubert de Foresta
Dr. G. Michon
Dr. Gregoire Vincent
Dr. Chip Fay
Dr. Mulyadi
Fred Stolle
Malcolm Cairns
Rien Beukeuma
Jim Rhosetko
Ir. Betha Lusiana
Ir. Suyanto MS
Yanti K
Eric Penot
Suseno
Martuah

LIST OF PARTICIPANTS
FOR THE SRAP WORKSHOP
29 – 30 SEPTEMBER 1997

No.	Name	Title	Address	Ph./Fax./e-mail
1.	Dr. Dennis P. Garrity	Director General	ICRAF, SEA Jl. Gunung Batu No. 5 Bogor	0251- 315234/315567
2.	Dr. Meine van Noordwijk	Senior Scientist	Ditto	Ditto
3.	Dr. Thomas P. Tomich	Senior Scientist	Ditto	Ditto
4.	Dr. Huber de Foresta	Senior Scientist	Ditto	Ditto
5.	Dr. G. Michon	Senior Scientist	Ditto	Ditto
6.	Dr. Chip Fay		Ditto	
7	Dr. Gregoire Vincent		Ditto	
8	Dr. Mulyadi		Ditto	
9	Malcolm Cairns		Ditto	
10	Fred Stole		Ditto	
11	Rien Beukeuma		Ditto	
12	Yanti K		Ditto	
13	Jim Roshetko		Ditto	
14	Eric Penot		Ditto	
15	Sandy Willliams		ICRAF-Muara Bungo	
16	Suseno		ICRAF - Bogor	
17	Martuah		ICRAF - Bogor	
18	Quirine Ketterings		ICRAF-Bogor	
19	Alexandra Kelfoun		ICRAF - Muara Bungo	
20	Philippe Courbet		ICRAF - Sanggau	
21	Ir. Ratna MSc		ICRAF - Muara Bungo	
22	Ir. Iwan Komardiwan		ICRAF - Muara Bungo	
23	Ir. Gerhard E.		ICRAF - Muara Bungo	
24	Ir. Ilahang		ICRAF – Sanggau	
25	Ir. Asngari		ICRAF – Sanggau	
26	Sujono		ICRAF- Sanggau	
27	Ir. Pratiknyo		ICRAF – Bogor	
28	Dr. Hisar Sihombing		BPP Sembawa	
29	Dr. Gede Wibawa		BPP Sembawa	
30	Dr. Chairil Anwar		BPP Sembawa	
31	Sofyan		ProRLK – Padang	
32	Mrs. Ellen Kramer		ProRLK- Padang	
33	Dr. Christoph S. Kehnert		SFDP – Sanggau	
34	Dr. AFS. Budiman		GAPKINDO – Jakarta	
35	Dr. Ridwan Dereindra			
36	Ketut Djati		USAID	
37	Christ Bennet		USAID	
38	Johannes Verhelst		USAID	
39	Dr. David Hissen		USAID	
40	Leo Abam		GAPKINDO Pontianak	
41	Ramli Sidin		GAPKINDO Padang	
42	Bratanta		GAPKINDO Jambi	
43	Dr. Zulkifli Zaini		CRIFC - Bogor	
44	Dr. Harahap		CRIFC – Bogor	

No.	Name	Title	Address	Ph./Fax./e-mail
45	Dr. Patrice Levang		ORSTOM	
46	Dr. Pascal Perez			
47	Dr. Jacques Rougetet		French Embassy	
48	Dr. Gabriel de Taffin		CIRAD	
49	Dr. Boutin		CIRAD	
50	Mr. Thomas Fairhurst		PPI – Singapore	
51	Mr. Ernst Mutert		PPI – Singapore	
52	Silvia Werner		Biotrop - ?	
53	Riikka Otsamo		Enso Forest – Sanggau	
54	Mr. Goran Adjers		Finantara Intiga – Jakarta	
55	Dr. Erwidodo		CASER – Bogor	

Appendix 1

SRAP WORKSHOP TENTATIVE PROGRAMME

FIRST DAY : PLENARY SESSION
presentation of SRAP results as well as outputs from scientists involved in the Rubber Agroforestry Initiative.

08:30	**Opening** by Dr. D. P. Garrity, Dr. AFS. Budiman and Eric Penot
09:00	**Main introduction to SRAP methodology and concepts** by Eric Penot
09:15	**Main agronomic results of RAS on-farm experimentation network** : in West Kalimantan by Eric Penot
09:30	in Jambi by Dr. Gede Wibawa and Ir. Gerhard
09:45	in West-Sumatra by Dr. Hisar Sihombing
10:00	Questions and discussion.
10:30	Coffee pause - Posters -
11:00	**The budwood garden programme and the rubber planting material policy** by Eric Penot
11:15	**Discussion**
11:30	**Farming system characterization** in Jambi by A. Kelfoun and Ir. Iwan K.
11:45	in West-Kalimantan by Philippe Courbet and Ir. Ilahang.
12:00	**Questions and discussions**
12:30	Lunch Pause
14:00	**Biodiversity study in jungle rubber** by Rien Beukeuma
14:15	**Questions and discussion**
14:30	Agronomic in depth research findings : . **Root Competition in RAS1** by Sandy Williams
14:45	**P fertilization in RAS 1** by Ir. Ratna A. MSc.
15:00	**Effect of burning** by Quirine Ketterings
15:15	**Questions and discussion**
15:40	**Coffee Pause**
16:00	**Plenary session : general discussion**

16:45 **Working groups presentation and participant distribution**

17:00 **End of the session.**

POSTERS IN DISPLAY

Poster of the Rubber IGPM availability and use in Jambi by Ir. Iwan K.
(IGPM = Improved Genetic Planting Material)
Posters of RAS and Soil Fertility (Ir. Ratna A. MSc. and Ir. Gerhard)
Poster of RAS 1.3 : Fertilization in RAS 1 by Ir. Gerhard

SECOND DAY : the participants are divided into several groups to provide comments and contribute to evaluation of the project findings and define further research recommendations.

Participants will be divided in the 4 main working groups :

09:00 to 12:00 WORKING GROUPS

- GROUP 1

  Lead : Dr. Gede Wibawa, Eric Penot, Dr. Dennis P. Garrity
  Associated ICRAF scientist : Dr. Meine van Noordwijk
  Topic: Agronomics of RAS: Dr. Gede Wibawa, Dr. D. Garrity

  Lead : Dr. Gregoire Vincent, Fred Stolle
  Associated ICRAF scientist : Dr. Gede Wibawa
  Topic :RAS Modelling and GIS/regional level land use evolution

- GROUP 2

  Lead : Eric Penot, Dr. Thomas P. Tomich, Dr. AFS. Budiman
  Associated ICRAF scientist : Dr. Chip Fay, Ir. Suyanto MS.
  Topic : Policy issues : planting material, development procedures;
  innovations adoption constraints, institutional constraints (land and tree tenure)

- GROUP 3

  Lead : Rien Beukeuma, Dr. Hubert de Foresta
  Associated ICRAF scientist : Dr. G. Michon
  Topic : Biodiversity conservation and evolution in RAS.

- GROUP 4

12:00 to 13:30 Lunch Pause

13:30 Plenary Session

Presentation of working groups outputs : 15 minutes for presentation + 15 minutes for discussion

13:30 Group 1

14:00 Group 2

14:30 Group 3

15:00 Coffee pause

15:30 Group 4

16:00	General discussion and Conclusion
17:00	End of the workshop

ANNEX 4

ICRAF seminar on
Indigenous strategies for intensification
in shifting cultivation in Southeast Asia

Indigenous Strategies for Intensification of Shifting Cultivation in S.E. Asia
Workshop Programme

June 22nd - 27th, 1997
New Mirah Hotel, Bogor,
Jalan Pangrango No. 9A, Bogor, Indonesia
Tel: 62-251-328044 / 312385 / 328434
Fax: 62-251-329423

Indigenous Fallow Management
IFM Network

SUNDAY, JUNE 22:

Afternoon -	Check-in at Hotel / Workshop Registration Hanging of Poster Presentations
7:00-8:00	Cocktails at Poolside
8:00-9:30	Dinner

MONDAY, JUNE 23:

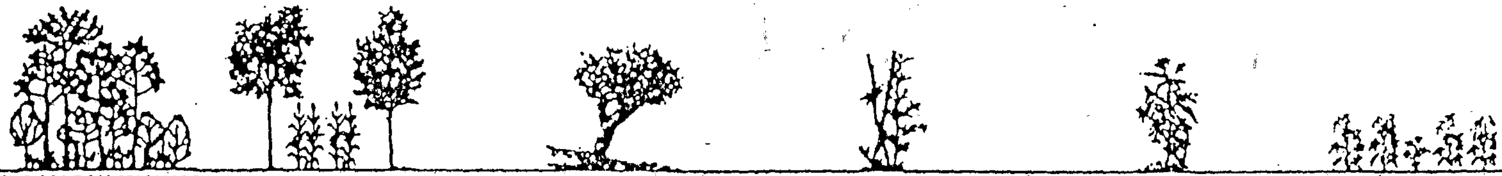
7:00-8:00	Breakfast

Opening Programme:
Session Chairperson: Dennis Garrity, Coordinator of ICRAF S.E. Asia Programme

8:00-8:20	Welcoming Remarks by Dr. Dennis Garrity, ICRAF
8:20-8:30	Remarks by CIIFAD, Cornell University - James Hafner, USA
8:30-8:40	Remarks by IDRC - Dr. John Graham, Singapore
8:40-8:50	Official Opening of the Workshop by Dr. Djaban Tambunan on behalf of Dr. Toga Silitonga, Director General of FORDA
8:50-9:20	Keynote Address: '*Working with Plants, and For Them: Indigenous Fallow Management in Perspective*' by Dr. Harold Brookfield, Australia
9:20-9:50	Background Synthesis Paper: *'Modification of Fallow Vegetation to Increase Swidden Productivity: Understanding Farmer Strategies in S.E. Asia'* - by Malcolm Cairns, Indo.
9:50-10:00	Discussion
10:00-10:30	Coffee Break & Group Photograph

ICRAF S.E. Asia　USAID　CIIFAD　ACIAR　ff　IDRC CRDI

Providing a Framework for the Plenary Sessions: Conceptualization of IFM Typologies



POLYCULTURES
GOAL: Harvest of tree products.

CONTINUUM

MONOCULTURES
GOAL: Rehabilitate soil properties after cropping period.

AGROFORESTS

LATEX-BASED:
- *Hevea brasiliensis*
  - widespread

RESIN-BASED:
- *Shorea javanica*
  Krui, Sumatra, Ind
- *Toxicodendrom vernicifera* /
- *Pinus yunnanensis*
  - west Yunnan, China
- *Styrax tonkinensis* /
- *S. benzoides*
  northern Laos
- *Styrax benzoin* /
- *S. paralleloneurus*
  - North Sumatra

FRUIT/NUT-BASED:
- *Durio zibethinus*
  - Kalimantan, Ind
- coconut palm
  Menado, Sulawesi, Ind
- commercial fruit orchards
  widespread

OTHERS:
- *Amomum compactum*
  northern Laos
- *Amomum subulatum*
  Himilayan foothills
- *Piper nigrum* (pepper)
  widespread in Ind
- *Camellia sinensis*
  S China / N Thailand
- *Coffea spp.*
  widespread
- *Zanthoxylum limonella*
  northern Thailand
- *Borassus sundaicus*
  Roti & Savu Islands Ind

MIXED SYSTEMS:
- Kenyah / Iban fallow enrichment
  Kalimantan Ind
- Ifugao woodlots
  Ifugao Phil

PERENNIAL-ANNUAL CROP ROTATIONS (*cyclical taungya system*)

TIMBER-BASED:
- *Cunninghamia lanceolata*
  southern China
- *Paraserianthes falcataria*
  Mindanao Phil
- *Melia sp*
  N W Vietnam
- *Tectona grandis*
  Laos
  N E India
- *Gmelina arborea*
  - widespread
- *Eucalyptus spp.*
  widespread
- *Pinus wallichiana*
  Bhutan
- *Santalum sp*
  central Laos
- cedar
  Kwangtung, China
- *Alnus nepalensis*
  S /S W Yunnan, China

NON-TIMBER:
- *Cinnamomum burmanii*
  Sumatra, Ind
- *Aquilaria sp*
  central Laos
- *Broussonetia papyrifera*
  northern Laos
- *Gigantochloa levis*
  Mindoro, Phil
- other bamboo spp
  Timor, Ind
  southern China
  northern Vietnam
- *Calamus caesius*
  Kalimantan Ind
- *Calamus sp* /
- *Plectocomia himalayana*
  southern China
- Talun kebun (mixed)
  West Java Ind

INTERSTITIAL TREE-BASED IMPROVED FALLOW

SIMULTANEOUS:
- *Alnus nepalensis*
  - Nagaland, India
  - S /S W China
- *Leucaena glauca* / *Gliricidia sepium*
  Naalad, Cebu, Phil
- *Leucaena leucocephala*
  Amarasi, Timor, Ind
  Sikka, NTT, Ind
  - South Sulawesi, Ind
  Mindoro, Phil
- *Sesbania grandiflora* / *Leucaena leucocephala*
  Sumba/Flores/Timor, Ind
- *Erythrina sp.* / *Desmodium sp* / *Hybiscus sp.*
  Flores, Ind
- *Albizzia chinensis*
  Sumba, Ind
- *Acacia villosa*
  Timor, Ind
- *Ficus spp.* (fodder)
  eastern Bhutan
- *Pinus kesiya*
  - northern India

SUCCESSIVE:
- *Tephrosia purpurea*
  - north Vietnam
- *Sesbania spp*
  - Isabela/Cagayan, Phil
  Yap, S Pacific
- *Alnus nepalensis*
  southwest China
- *Casuarina oligodon*
  New Guinea
- *Alnus japonica*
  N Luzon Phil
- *Parasponia rugosa* /
- *Schleinitzia novo-guineensis*
  Papua New Guinea
- *Hibiscus tiliaceous*
  Yap S Pacific

RETENTION / PROMOTION OF PREFERRED VOLUNTEER SPP.

ECONOMIC UTILITY:

Food
- bamboo shoots
- native vegetables & other wild food plants

Fiber
- construction materials, e.g., planting *Corypha utan* Lan. & other palm spp. before abandoning swidden to provide roofing materials for field hut construction in next cropping phase
- harvest of poles useful for house or hut construction
- *Imperata cylindrica* & other spp. of thatch-grass for roof construction

Fodder
- *Imperata cylindrica* - & other native forages
- Fuel
- Medicinal Herbs

Stimulants
- *Nicotiana tabacum* (tobacco)
- *Piper beetle* (beetle leaf)
- + spp. providing shade, pleasant smells, nectar for honey production, attracting wildlife for hunting, etc
  - all widespread in subsistence swidden communities

ECOLOGICAL FUNCTIONS:
- - selective felling to retain 'mother trees' & accelerate recovery of secondary forest
- - protect existing coppices: limit cropping period, fire management & avoid tillage

SHRUB-BASED ACCELERATED FALLOW

NON-N FIXING:

Compositae spp. (*N-accumulating?*)
- *Austroeupatorium inulifolium*
  - West Sumatra, Ind
- *Tithonia diversifolia*
  - Mindanao, Phil
- *Chromolaena odorata*
  - Luang Prabang, Laos
  - Nusa Tenggara, Ind
  - Kalimantan, Ind.
  - Yunnan, China
  - northern Thailand
  - widespread below 1000 m asl

Other
- *Mallotus barbatus*
  - northern Thailand
- *Ricinus communis*
  - Timor, Ind.
- *Tecoma stans*
  - Timor, Ind

N-FIXING:
- *Mimosa invisa*
  - Leyte, Phil (spiny)
  - northern Thailand (spineless)
- *Cajanus cajan*
  - Mindoro, Phil

VINY LEGUMES AS SEASONAL FALLOWS

LEGUME ROTATIONS:
- *Phaseolus calcaratus*
  - northern Vietnam
  - northern Thailand
- *Amphicarpaea linearis*
  - Hainan Island, China
- *Flemingia vestita*
  - N E. India
- *Dolichos lablab*
- *Vigna sinensis*
  - northern Thailand
- *Calopogonium mucunoides*
  - Leyte, Phil
- *Pachyrhizos tuberosis*
  - northern Vietnam

- increasing integration of legume components into cropping sequence + ruminant livestock

M F Cairns

Plenary Session I: Interstitial Tree-Based Fallows
Session Chairperson: Dr. P.S. Ramakrishnan, INDIA

Oral Presentations:

10:30-10:50	*'Alnus nepalensis-Based Agroforestry Systems in Yunnan, Southwest China'* by Guo Huijun and Xia Yongmei, P.R. China, and Christine Padoch, USA
10:50-11:10	*'Shifting Forests in North-Eastern India: Management of Alnus nepalensis as an Improved Fallow Species in Nagaland'* by Malcolm Cairns, Supong Keitzar and Amenba Yaden, India
11:10-11:30	*'Management of Fallow Species Composition with Tree Planting in Papua New Guinea'* by R. Michael Bourke, Australia
11:30-11:50	*'Intensification of Indigenous Fallow Rotation Using Leucaena leucocephala'* by Fahmuddin Agus, Indonesia
11:50-12:10	*'The Role of Leucaena in Village Cropping and Livestock Production in Nusa Tenggara Timur, Indonesia'* by Colin M. Piggin, Philippines
12:10-1:00	Discussion Period

Related Poster Presentations:

- *'The Naalad Improved Fallow System and its Implications to Global Warming'* by Rodel D. Lasco, Philippines
- *'Pruned-Tree Hedgerow Fallow Systems'* by Peter Suson and Dennis Garrity, Philippines
- *"The Use of Sesbania grandiflora (L) Pior. as a Farmers' Answer to Declining Soil Fertility in Swidden Agriculture in North Central Timor'* by Johan Kieft, Indonesia
- *'Initial Results in SALT Model Application and Some Recommended Solutions to Reduce Shifting Cultivation for Ethnic Minority Farmers in Daklak Province, Vietnam'* by Phan Quoc Sung and Pham Van Hien, Vietnam

1:00-2:00	Lunch Break
2:00-3:30	Poster Session (1st day's categories)

Plenary Session II. Shrub-Based Accelerated Fallows
Session Chairperson: Dr. Hoang Xuan Ty, VIETNAM

Oral Presentations:

3:30-3:50	*'Farmer-Improved Short-Term Fallows Using a Spiny Legume Benet (Mimosa invisa Mart.), in Western Leyte, Philippines'* by Edwin Balbarino, David M. Bates, Z. de la Rosa, and Julito Itumay, Philippines
3:50-4:10	*'Fallow Improvement in Upland Rice Systems with Chromolaena odorata'* by Walter Roder, Soulasith Maniphone, Boonthanh Keoboulapha, and Keith Fahrney, Lao P.D.R.
4:10-4:30	*'Spontaneous Adoption and Management of Tecoma stans Fallows by Local Farmers in a Semi-Arid Region of East Nusa Tenggara'* by Tonny Djogo, Muhamad Juhan, Aholiab Aoetpah, and C. Nalle, Indonesia
4:30-5:30	Discussion Period

Related Poster Presentations:

- *'Use and Management of Mimosa diplotricha var. inermis as a Simultaneous Fallow in Orange Orchards and Upland Annual Crop Cultivation in Northern Thailand'* - by Klaus Prinz and Somchai Ongprasert, Thailand
- *'Management of Austroeupatorium inulifolium-Based Fallows by Minangkabau Farmers in Sumatra, Indonesia'* by Malcolm Cairns, Indonesia

6:00-7:00 Dinner

TUESDAY, JUNE 24:

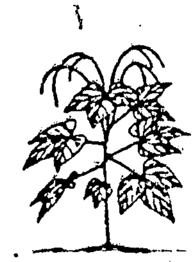
7:00-8:00 Breakfast

Plenary Session III. Herbaceous Legumes
Session Chairperson: Dr. Kurniatun Hairiah, INDONESIA

Oral Presentations:

8:00-8:20	*'Flemingia vestita-Based Indigenous Fallow Management in N.E. India'* by P.S. Ramakrishnan, India
8:20-8:40	*'Soil Improvement and Conservation Using Nho Nhe Bean (Phaseolus calcaratus Roxb.) in Upland Areas of Northern Vietnam: Initial Results from a Case Study'* by Nguyen Tuan Hao, Ha Van Huy, Huynh Duc Nhan, and Nguyen Thi Thanh Thuy, Vietnam
8:40-9:00	*'Growing Yazhou Hyacinth Beans in Hainan Island in the Dry Season'* by Lin Wei-Fu, Jiang Jusheng, Li Wuige, Xie Guishui, and Wan Yuekun, P.R. China
9:00-9:30	Discussion Period

Related Poster Presentations:



- *'Use and Management of Viny Legumes as Accelerated Seasonal Fallows in Intensified Shifting Cultivation in Northern Thailand'* by Somchai Ongprasert and Klaus Prinz, Thailand

9:30-10:00 Coffee Break

Plenary Session IV. Retention-Promotion of Volunteer Spp. with Economic / Ecological Value
Session Chairperson: Dr. Guo Huijun, P.R. CHINA

Oral Presentations:

10:00-10:20	*'Relict Emergents on Fallow Swiddens of the Lawa in Northern Thailand: Ecology and Economic Potential'* by Dietrich Schmidt-Vogt, Germany
10:20-10:40	*'Successional Forest Development in Abandoned Swidden Plots of Hmong, Karen and Lisu Ethnic Groups'* by Chaleo Kanjunt, Thailand
10:40-11:00	*'Wildfood Plants: Alternative Species from Fallow Lands of the Cordillera Region, Philippines'* by Fatima T. Tangan, Philippines (also accompanying poster)
11:00-11:20	*'Farmer-Initiated Forage Management for Stabilization of Shifting Cultivation Systems'* by Viengsavanh Phimphchanhvongsod and Peter Horne, Lao P.D.R.
11:20-11:40	*'Kammu Fallow Management in Lao P.D.R.'* by Damrong Tayanin, Sweden
11:40-12:30	Discussion Period

Related Poster Presentations:

- *'Commercialization and the Stimulation of Economically Valuable Species in the Fallow Vegetation by Bidayuh Shifting Cultivators in Sarawak, Malaysia'* by Paul Burgers, Zimbabwe
- *'The Potential of Wild Vegetables for Permanent Cultivation or as Fallow Improvement Crops in Shifting Cultivation, Sarawak, Malaysia'* by Ole Mertz, Denmark
- *'Selling Imperata: Managing Grasslands for Profit'* by Lesley Potter and Justin Lee, Australia
- *'When Shifting Cultivators Migrate to Work in the Cities, How to Rehabilitate the Grasslands?'* by Borpit Maneeratana and Wichai Songwadhana, Thailand
- *'Natural Forest Regeneration from an Imperata Fallow: The Case of Pakhasukjai'* by Janet Durno, Canada and Tuenjai Deetes and Juthamas Rajchaprasit, Thailand

12:30-1:30	Lunch Break
1:30-2:30	Poster Presentations (all categories) Signup for Working Groups Parts I and II Submission of Air Tickets to Travel Agent for Flight Reconfirmations

Plenary Session V. Perennial-Annual Rotations
Session Chairperson: Dr. John Graham, IDRC SINGAPORE

Oral Presentations:

2:30-2:50 *'Forestry Management Strategies Among Hmong and Other Upland Cultivators of the Southwest China Borderlands: The Case of Cunninghamia lanceolata'* by Nicholas Tapp, U.K. and Nicholas Menzies, Kenya

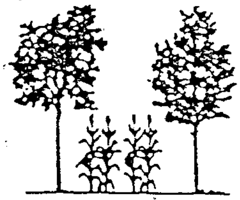
2:50-3:10 *'Teak Production by Shifting Cultivators in Northern Lao P.D.R.'* by Peter Hansen, Houmchitsavath Sodarak, and Sianouvong Savathvong, Lao P.D.R.

3:10-3:30 *'Melia spp. in Indigenous Fallow Management: An Experience from Northern Vietnam'* by Le Trong Cuc and Tran Duc Vien, Vietnam

3.30-3:50 *'Technical and Economic Innovations in Swidden-Based Rattan Cultivation of Benuaq-Dayak People in the Middle Mahakam, East Kalimantan, Indonesia'* by Hideyuki Sasaki, Japan.

3:50-4:10 *'Indigenous Management of Paper Mulberry (Broussonetia papyrifiera) in Swidden Rice Fields and Fallows in Northern Laos'* by Keith Fahrney, Onechanh Boonnaphol, Boonthanh Keoboulapha, and Soulasith Maniphone, Lao P.D.R.

4:10-5:00 Discussion Period



Related Poster Presentations:

- *'Multipurpose Trees as Improved Fallows: An Economic Assessment'* by Peter Grist, Ken Menz, and Rohan Nelson, Australia
- *'A Cost-Benefit Analysis of Gmelina Hedgerow Fallow System in Claveria, Northern Mindanao, Philippines'* by Damasa Macandog and Patrick M. Rocamora, Philippines
- *'The Utilization of Dryland Through Bamboo Vegetation as a Fallow Crop in Timor Island, Nusa Tenggara Timur, Indonesia'* by Abdullah Bamualim, J. Triastono, E. Hosang, and T. Basuki, Indonesia and S.P. Field, Australia

Plenary Session VI. Agroforests
Session Chairperson: Dr. Rodel Lasco, PHILIPPINES

Oral Presentations:

5:10-5:30 *'Talun Kebun System: Conflicts and Prospects. A Case Study in the Upper Citarum River Basin, West Java'* by Nani Djuargsih, Payat Ruchiyah, Parikesit, and Oekan S. Abduellah, Indonesia

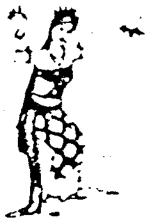
5:30-5:50 *'From Shifting Cultivation to Sustainable Jungle Rubber in Indonesia: A History of Innovations Integration for Smallholders in the Peneplains of Sumatra and Kalimantan Since the Turn of the Century'* by Eric Penot, Indonesia

5:50-6:10	*'Lacquer Agroforestry System of Lemo in Yunnan, China'* by Long Chun-Lin, P.R. China
6:10-7:00	Discussion Period
7:00-7:10	Briefing on following day's field trip - by Institute of Ecology team, Padjadjaran U.

Related Posters:

- *'"Ma Kwaen" (Zanthoxyliem limonella): A Jungle Spice Used in Swidden Intensification in Northern Thailand with Indigenous Technology'* by Peter Hoare, Borpit Maneeratana, and Wichai Songwadhana, Thailand
- *'The "Tagui Gru' System and Other Karen Fallow Management Practices in Thailand: Building on Indigenous Technologies as a Strategy for Land Use Intensification'* by Payong Srithong, Thailand
- *'Does Tree Diversity Affect Soil Fertility? A Critical Hypothesis and Initial Findings in the Alternative Fallow Management Systems of West Kalimantan'* by Deborah C. Lawrence, Dwi Astiani, Marlina Syazhaman-Karwur, and Isabella Fiorentino, Indonesia
- *'Preliminary Study on Rubber Plantations as a Local Alternative to Shifting Cultivation in Yunnan Province, China'* by Guangxia Cao and Lianmin Zhang, P.R. China
- *'Alnus - Cardamom Agroforestry System: Potential for Stabilizing Upland Shifting Cultivation in the Eastern Himalaya'* by Rita Sharma, India
- *'Impetus and Trend of Agroforestry Economic Plants Development at Village Level'* by Chen Aiguo, Guo Huijun and Cui Jinyun, P.R. China
- *'Fallow Management with Styrax tonkinensis for Benzoin Production in Upland Cultivation Areas in Northern Lao P.D.R.'* by Sianouvong Savathvong, Manfred Fischer, and Khongsak Pinyopusarerk, Lao P.D.R

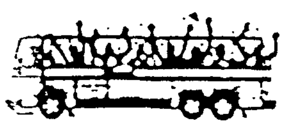
7:30	Dinner
8:30	Cultural Show & Open Bar



WEDNESDAY, JUNE 25:

All day field trip to view '*talun kebun*' system practiced in Ciwidey, West Java, and associated village-level processing of fallow products.
Hosted by the Institute of Ecology, Padjadjaran University.

Refer to separate field trip programme for details.



Come prepared for rain (umbrella) or shine (sunglasses and hat)!

THURSDAY, JUNE 26:

7:00-8:00 Breakfast

Plenary Session VII. Multi-System Papers Cutting Across Categories
Session Chairperson: Pelzang Wangchuk, BHUTAN

Oral Presentations:

8:00-8:20 *'Hani Practices of Intensification of Shifting Cultivation in Xishuangbanna, Southwest China'* by Xu Jianchu, P.R. China

8:20-8:40 *'Rebuilding Soil Properties During the Fallow Period: Indigenous Innovations Practiced in the Highlands of Vietnam'* by Hoang Xuan Ty, Vietnam

8:40-9:00 *'Strategies of Shifting Cultivators in the Intensification Process'* by United Nations Office for Project Services, Asia Office (paper presented by Phrang Roy, Malaysia)

9:00-9:30 Discussion Period

Related Poster Presentations:

- *'Recent Changes and Farmer Innovations in the Management of Shifting Cultivation Land in Bhutan'* by T. Dukpa, P. Wangchuk, Rinchen, K. Wangdi, and W. Roder, Bhutan
- *'Changing Land Use Practices by Farmers in Luang Prabang Province, Lao P.D.R'* by Rogier Eijkens and Phanthong Masixonxay, Lao P.D.R.
- *'Improved Fallow Techniques in San Jose, Occidental Mindoro, Philippines: A First Step Toward Upland Management Based Primarily on Perennial Species'* by Michael Robotham, USA
- *'Documentation and Analysis of Indigenous Fallow Management Systems in Selected Areas of the Cordillera'* by Montanosa Research and Development Center, Philippines
- *'Improving and Uses of Fallow Lands in Barren Hills of Sandiu People in Luc Ngan District of Bac Giang Province of Northern Vietnam'* by Ta Long, Vietnam
- *'Local Knowledge of Traditional Shifting Cultivation in the Midlands of Northern Vietnam's Mountainous Regions'* by Nguyen Thi Thanh Nga, Vietnam
- *'Agroforestry Production Practices of Minority Groups in Vietnam's Northern Mountainous Region'* by Tu Quang Hien, Vietnam
- *'Shifting Cultivation in the Central Highlands of Vietnam: Existing Problems and Suggestions for Control'* by Tran Trung Dung, Vietnam
- *'PNG Highland Experiences and the Future of Shifting Cultivation"* by Bire Bino, Papua New Guinea

Plenary Session VIII. Thematic Papers: Property Rights, Markets & Institutions
Session Chairperson: Dr. Uraivan Tan-Kim-Yong, THAILAND

Oral Presentations:

9:30-9:50	*'Productive Management of Swidden Fallows: The Interplay of Market Forces and Institutional Factors in Isabela, Philippines'* - by Paulo N. Pasicolan, Philippines
9:50-10:10	*'The Role of Land Tenure on Development of Cinnamon Agroforestry in Kerinci, Sumatra'* by Suyanto, Thomas Tomich, and Keijiro Otsuka, Indonesia
10:10-10:30	*'The Development of Central Sumatran Traditional Fallow Systems in a Changing Environment'* by Silvia Werner, Indonesia
10:30-11:00	Discussion Period

Related Poster Presentations:

- *'The Role of Policy and Market Institutions in Determining the Feasibility of Rattan Cultivation Within Shifting Cultivation Systems'* by Brian Belcher, India
- *'Effect of Land Allocation to Farmers on Shifting Cultivation in Vietnam A Case Study of Sinh Pinh Commune, Tua Chun District, Lai Chau Province'* by Dinh Van Quang Vietnam
- *'Building on Traditional Practices to Improve the Productivity of Natural Resource Management: A Community Based Approach'* by Tawatchai Ratanasorn, Thailand
- *'The Pivotal Role of Indigenous Regulatory Institutions in Support of Sustainable Swidden Farming Systems in Lao P.D.R.'* by Phouang Parisak Pravongviengkham, Lao P.D.R.

11:00-11.30	Coffee Break

Synthesis Reports:
Session Chairperson: Onechanh Boonnaphol, LAO P.D.R.

11:30-11:40	Interstitial Tree-Based Improved Fallows - by Dr P.S. Ramakrishnan, India
11:40-11:50	Shrub-Based Accelerated Fallows - by Dr. Hoang Xuan Ty, Vietnam
11:50-12:00	Herbaceous Legume Short Fallows - by Dr Kurniatun Hairiah, Indonesia
12:00-12:10	Retention-Promotion of Volunteer Spp with Economic / Ecological Value by Dr Guo Huijun, China
12:10-12:20	Perennial-Annual Rotations - by Dr John Graham, Singapore
12:20-12:30	Agroforests - by Dr. Rodel Lasco, Philippines
12-30-12:40	Multi-System Papers - by Pelzang Wangchuk, Bhutan
12:40-12:50	Thematic: Property Rights, Markets & Institutions - by Dr Uraivan Tan-Kim-Yong, Thai
12:50-1:10	*'Farmer-Developed Fallow Management Innovations in Southeast Asia. The Opportunity for Strategic Regional Partnerships'* by James Hafner, Ellen McCallie, and Lucy Fisher, Cornell University, USA

1:10-2:00	Lunch Break Return of Confirmed Air Tickets to Participants

Part I Working Groups: Consolidation of Current Knowledge

'What have we learned so far?'

Guiding Question:

'What are the key factors that lead to successful indigenous fallow management systems and how can these be transferred to other areas where collapsing swidden systems are endemic?'

2:00-3:00	Working Groups: Group 1: Socio-Cultural Aspects - co-chaired by Uraivan Tan-Kim-Yong and Nick Tapp Group 2: Bio-Physical Aspects - co-chaired by Dennis Garrity and Peter Cooper Group 3: Property Rights & Marketing - co-chaired by Tom Tomich and Chip Fay
3:00-3:30	Tea Break
3:30-5:30	Working Groups (cont.): Exercise in Hypothetical IFM Technology Transfer Within S.E. Asia's Uplands

IFM Case Studies:

Fallow Species	Reference Paper	IFM Origin	Extension Target
• *Alnus nepalensis*	Session I - Cairns et. al.	N.E. India	N. Philippines
• *Tithonia diversifolia*	Session II - Daguitan et. al.	N. Philippines	N.E. India
• *Melia sp.*	Session V - Cuc and Vien	N. Vietnam	S. China
• *Broussonetia papyrifiera*	Session V - Fahrney et al.	N. Laos	N. Vietnam
• Rattan	Session VII - Jianchu	S. China	N. Laos

7:00	Dinner Private bar for after-dinner socializing

FRIDAY, JUNE 27:

7:00-8:00	Breakfast
8:00-9:00	Report on Group Findings from Part I
8:00-8:20	Socio-Cultural Report
8:20-8:40	Biophysical Report
8:40-9:00	Property Rights & Marketing Report
9:00-9:30	Discussion
9:30-10:00	Coffee Break

Part II Working Groups: Formulating a Research and Development Agenda

'What needs to be learnt and how?'

Guiding Question:

'Given our existing knowledge of indigenous fallow management systems and their potential, what are the elements of a strategic agenda for continued research and promotion of the most promising IFM technologies in the future?'

10:00-12:00	Working Groups (cont.)
	Group 1: Socio-Cultural Aspects - co-chaired by Uraivan Tan-Kim-Yong and Nick Tapp
	Group 2: Bio-Physical Aspects - co-chaired by Dennis Garrity and Peter Cooper
	Group 3: Property Rights & Marketing - co-chaired by Tom Tomich and Chip Fay
12:00-1:00	Lunch Break
1:00-3:00	Working Groups (cont.)
3:00-3:30	Tea Break
3:30-4:30	Report on Group Findings from Part II
3:30-3:50	Socio-Cultural R&D Agenda
3:50-4:10	Biophysical R&D Agenda
4:10-4:30	Property Rights & Marketing R&D Agenda

Part III Concluding Plenary Session: Laying the Groundwork for a Regional Thrust on IFM
Session Chairperson: Chun Lai

Guiding Question:

'What are the needed components to make it happen?'

4:30-5:30
- Regional Networking / Communications
- Identification of Potential Funding Resources
- Governing Policy on Intellectual Property Rights Associated with IFM
- Etc.

Closing Remarks

6:00 - Dinner at Cafe Botanicus, inside Bogor's Botanic Gardens
Distribution of Workshop Certificates & Group Photographs

SATURDAY, JUNE 28:

7:00-8:00 Breakfast

9:00-11:00 Optional Tour of the Bogor Palace
staggered Departure of Participants

Acknowledgement:
The organizers wish to explicitly acknowledge that the fallow management practices and underlying knowledge presented at this workshop are the intellectual property of Southeast Asia's swidden farmers. This information should be used, with proper accreditation, with the aim of improving their welfare.-

From Shifting Cultivation to Sustainable Jungle Rubber in Indonesia: A History of Innovations Integration for Smallholders in the Peneplains of Sumatra and Kalimantan Since the Turn of the Century

By Eric Penot*

The peneplains of Sumatra and Kalimantan below the altitude of 500 meters (our study area) were scarcely inhabited at the turn of the 19th century with a population density inferior to 4 inhabitants/km², mainly relying on shifting cultivation of upland rice. The introduction of rubber by private Dutch estates in the 1910's triggered a radical change in the landscape evolution but not in farmers practices, at least at the beginning. As estates adopted monoculture right from the beginning, trying to maximize rubber production, farmers saw and exploited immediately the possibility of growing rubber on a very extensive way by enriching their fallows (belukar in Indonesian) with unselected rubber seedlings that was available and free. Planting rubber during, or after, upland rice was a very marginal supplementary amount of work, with no risks and more important: no cost Rubber used to grow with the secondary forest in a complex agroforestry system called 'jungle rubber"

Productivity was sufficient to raise a very incentive income however rubber taping occurs with a delay compared to rubber monoculture in estates.

The advantages of jungle rubber are clear: no cost, no labour required for maintenance during immature period, income diversification with fruits, rattan, timber and other NTFP (non timber forest products) from the agroforest. Indirect benefits are environmental with soil conservation and rehabilitation of degraded lands. Originally, the adoption of this system did not change farmers practices and, beside rubber production, they continued to slash and burn new plots every year. At that stage on can still consider jungle rubber as an "enriched fallow with rubber ".

Estates began to raise their own research programme in the 1920's leading to the adoption of several important innovations, fertilization, weeding level, exploitation systems among them improved planting material, the clones, has been the most important in terms of yield. Meanwhile farmers began to produce several innovations, with no cost, called "endogenous innovations" such as planting in lines, a minimum weeding (once a year) .mainly through the improvement of some rubber farming practices. At that stage as the aim was definitely to establish a rubber system minimizing capital and labour investment, farmers shifted from an "enriched fallow with rubber" to a real "complex rubber agroforestry system".

The productivity of jungle rubber being low (500 kg/ha/year of rubber) compared to that of estates using clones (1500 to 2000 kg/ha/year), and after having completed the possibilities of endogenous innovation production, farmers began to be interested to include "external innovations" such as clones, fertilization and good tapping systems.

Some who had access to clonal rubber in monoculture began also to develop innovations such as intercropping during immature period and planting of perennial trees (or selection of those from natural regeneration) such as fruit and timber trees creating therefore an "improved rubber based complex agroforestry system" where the original aim of improving the fallow has disappeared before the willingness to establish a real

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cropping system. These practices were still forbidden in rubber development project 5 years ago only. Population increase, land scarcity in some areas and other more productive crop opportunity force farmers to move to a more productive Rubber Agroforestry System (RAS).

Research in agroforestry has been very recently focused on how to integrate indigenous knowledge with jungle rubber and external innovations to raise productivity conserving benefits of agroforestry practices in terms of environment and biodiversity.

Keywords: shifting agriculture, complex agroforestry systems, jungle rubber, rubber cropping patterns, innovations adoption process

Lacquer Agroforestry System of Lemo in Yunnan, China

By Long Chun-Lin*

Lacquer tree (*Toxicodendrom vernicifera*) planted in swidden field by Lemo people in NW Yunnan of China is reported to the outside world for the first time. The lacquer agroforestry system is tentatively studied. The seedling breeding, cultivation and management of lacquer trees, and lacquer tapping are carried out by individual household. Only the men have the rights to cultivate lacquer seedlings and tape lacquer in Lemo society. The lacquer agroforestry system afford the Lemo people 70-85% cash income and better environmental value. This unique agroforestry system is being threatened by lacquer price dropping. In additional, the Lemo's traditional swidden cultivation is briefly introduced in the present paper.

Keywords: Lemo, lacquer, lacquer agroforestry system, swidden fallow, Kongji, alder

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ANNEX 5

CIFOR WORKHOP ON

THE MANAGEMENT OF SECONDARY FORESTS IN INDONESIA.

CIFOR
CENTER FOR INTERNATIONAL FORESTRY RESEARCH
office address: Jalan CIFOR, Situ Gede, Sindangbarang, Bogor Barat 16680, Indonesia
mailing address: P.O. Box 6596 JKPWB, Jakarta 10065, Indonesia
tel: +62 (251) 622 622, *fax:* + 62 (251) 622 100, *e-mail:* cifor@cgnet.com

FIRST ANNOUNCEMENT
INTERNATIONAL WORKSHOP

THE MANAGEMENT OF SECONDARY FORESTS IN INDONESIA

(November 12-14, 1997, Bogor, Indonesia)

Hosted by:
Center for International Forestry Research (CIFOR)

and

Sponsored by:

USAID

Invitation to attend and first call for paper titles and abstracts

Contact address: *Dr. P. Sist, CIFOR, PO Box 6596, JKPWB Jakarta 10065, Indonesia fax: 62 251 622 100, tel: 622 622, email: psist@cgnet.com*

Recycled paper

Workshop organization

The main objective of the workshop is to define the research priorities in the issue of Secondary forest management in Indonesia. Secondary forests are defined here as logged-over forests, pure stand of pioneer vegetation, regenerating forests after high disturbance (fire, shifting cultivation). This definition allows a wide range of researchers in forestry issue to participate at this meeting. Although this meeting focuses on Indonesia, case study papers from South East Asia region are very welcome. Representatives of the Ministry of Forestry of Indonesia are invited to participate actively to this workshop particularly on issues related to forest policy in Indonesia. Participants are invited to present papers related to the following issues:

Session 1: **Ecology of secondary forests of South East Asia**
- Structure, species composition, biodiversity
- Impact of mechanized logging and other human activities on forest dynamics
- Secondary forests and soils conservation or rehabilitation
- Methods of inventory and monitoring

Session 2: **Economic value, use and management**
- Management of secondary forests for timber harvesting (second rotation)
- Community-based forest management
- Silvicultural treatments (enrichment planting, liberation)
- Conservation of soil and biodiversity

Session 3: **Indonesian policy for secondary forest management**
- TPTI
- KPHP
- Future Policy

Participation: registration forms, abstract deadline

Participants wishing to attend the workshop must fill the registration form with the title of their communication to Dr. Sist (see address below) in CIFOR. **The registration forms must be received by July 10th, 1997. Limited funding is available to support travel by some participants. This will be allocated in priority to participants presenting a paper at the workshop and coming from parts of Indonesia other than Java, or from foreign developing countries.** Participants will be notified of the decision of the organizing committee on the covering of traveling and hotel costs before July 30th, 1997.

Since participants may come from different countries, the communication must be in English. Abstract must be received by **September 30th, 1997** and the deadline for receiving the final manuscript is **October 30th, 1997**. The participants will be informed of the decision of the editing committee on the selection of their communication for the final publication of the proceedings. The authors may be also requested to make substantial revisions to answer to the quality criteria of the publication.

INTERNATIONAL WORKSHOP

THE MANAGEMENT OF SECONDARY FORESTS IN INDONESIA

17-19 November, 1997
Bogor Lakeside, Bogor, Indonesia

OBJECTIVES

As a result of deforestation rates in the tropics, secondary forests cover is today, in many tropical countries more extensive than primary forests. Secondary forests are already partly fulfiling some of the economic and ecological services that were provided by primary forests. As the area of secondary forests increases, generally at the cost of primary forests, research on the management of secondary forests to achieve sustainability must be regarded as the main priority.

Although many research institutions, including CIFOR, have been carrying out studies on the ecological and economic value of secondary forests, a synthesis of our knowledge of the management of secondary forest has still to be done. Secondary forests are defined here as forests heavily disturbed by human activities (mechanized logging, traditional timber harvesting, shifting cultivation) or natural disasters. This synthesis would enable us to identify the research priorities to be undertaken and the key factors for successful application of secondary forest management. In March 1997 CIFOR has started a literature review for the humid tropics in the three continents (Africa, Asia & Pacific islands and America[♠]). The main objective is to collect a comprehensive set of references on the management of secondary forest emphasizing silvicultural practices. The outputs of this study will be an annotated bibliography in the form of a CD-ROM and an accompanying booklet identifying the scope of the CD. A final synthesis in the form of a book (monograph) is being planned for year 2000. A number of workshops will be conducted in each of the tropical regions in order to present and discuss contributed papers from collaborators. This workshop is therefore the first for the SE Asian region with a focus on Indonesia. Its main objectives are to:

- Create a forum for discussion on the management of secondary forests in Indonesia and South East Asia in general.
- Define the research priorities for achieving sustainable management of secondary forests in South East Asia.
- Gather comments and recommendations on the structure and organisation of the synthesis proposed by CIFOR

[♠] The main coordinators for this synthesis are:
C. Sabogal for tropical America, P. Sist for tropical Asia and Pacific islands, R. Nasi for tropical Africa.

During the first two days, about 25 papers will be presented and discussed in plenary sessions. The third day will aim to finalise the discussions by making recommendations on the specific thematic areas covered by each working group. In order to set up a framework of discussion for each working group the following issues are proposed*:

Working Group 1: Classification, covering and ecology of secondary forests

1. What are secondary forests?
   - Should logged forest be included in this study?
   - To what degree does primary forest have to be disturbed to make it secondary?
   - Can agroforestry be considered secondary forest?
2. What would be the best classification system for natural forest resource management at different scales: regional, national and concessional?
3. Research needs on forest resource assessment.
4. Research needs on the ecology of secondary forests for typology

Working Group 2: Economic and environmental value, silviculture and management

1. Comments on and editing of the comparative table on the uses of logged, regrowing and primary forests
2. Research needs in the promotion of pioneer species for timber harvesting
3. What is the value of logged forest for the harvesting of NTFPs?
4. Research needs on forest dynamics, growth and yield and on impact of harvesting on forest ecosystems
5. Are new silvicultural concepts needed?
6. Can logged forests in Indonesia sustain a second felling cycle under TPTI or TJTI and KPHP? NO

Working Group 3 : Policy for sustainable forest management

1. Can natural logged forests sustain timber production through the next century? YES if law is enforced if not no
2. Can timber plantation supply timber industry in near ~~a closed~~ future?
3. What are the social issues in the management of secondary forests? Are they different from those known for primary forests?
4. Research needs on future scenarios of economic trends of the wood market (timber and NTFPs).
5. How can forest policy promote sustainable management of secondary forests?

* The discussion in the working groups should not be limited only to the questions here listed. This list intends to be a starting point for discussion and participants are encouraged to raise other issues they think important and relevant to the workshop.

In addition to these specific questions to each working group, common questions related to the structure and organisation of the literature review initiated by CIFOR will have to be answered by all the working groups. These are:

1. Title: Comment on the following propositions

Management of secondary forests in the humid tropics. A review and annotated bibliography with emphasis on silviculture.

or

Management of logged and secondary forests in the humid tropics. A review and annotated bibliography with emphasis on silviculture.

Others suggestions

2. Comments on the following structure and main thematic areas:

Are the following chapters (I to IV) properly developed and organised?
Are the following chapters relevant for this literature review?

I. Forest Resource Assessment: Classification and Covering
1. Classification
2. Covering
3. Conclusions and research priorities

II. Economic Value, Harvesting and Environmental Services
1. Timber production
2. NTFPs and other uses
3. Environmental value and services
4. Conclusions and research priorities

III. Silviculture and Management
1. Silvicultural systems
2. Forest management systems
3. Conclusions and research priorities

IV. Policy and Institutional Aspects

1. Forest administration and conflicts
2. Market trends and eco-certification
4. Research priorities

V. Conclusions and Discussion. Recommendations and research priorities for the sustainable management of secondary forest

ANNEX 6

GAPKINDO SEMINAR

Bali, August 1997

GAPKINDO is most thankful

to the following sponsors of our event :

PT. MEKAR KREASIMANDIRI, PALEMBANG

SPHERE CORPORATION SDN. BHD., PORT KLANG

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GOODPACK SYSTEM PTE LTD, SINGAPORE

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GAPKINDO

ON THE OCCASION OF THE ELEVENTH CONGRESS OF GAPKINDO (RUBBER ASSOCIATION OF INDONESIA), THE GOVERNING BOARD AND ALL THE MEMBERS OF THE ASSOCIATION CORDIALLY INVITE :

MR & MRS. O.K. CORNEL
GAPKINDO PUSAT
JAKARTA

TO PARTICIPATE IN THE

RUBBER INDUSTRY FORUM

AND

ANNUAL DINNER

VENUE : AGUNG BALL ROOM
GRAND BALI BEACH HOTEL
SANUR-BALI
ON SATURDAY, 2 AUGUST 1997

RUBBER INDUSTRY FORUM

hour	
08.30	Registration
09.00	Welcome Speech by the (new) Chairman of Gapkindo and introduction of the new Governing Board (1997-2000).
09.15	Opening Address by the Director General of Agro and Forestry Industries, Ministry of Industry and Trade, (represented by Agus Setiati) **Ir. Sujata**
09.30	**Presentation by Dr. C. Suan Tan** (Advanced Strategies Consultancy Ltd, Hongkong) **OUTLOOK ON THE NR INDUSTRY. IMPLICATION OF INDUSTRIAL GLOBALIZATION.**
10.00	Coffee-break
10.30	**Presentation by Mr. George Sulkowski** (Centrotrade Singapore Pte. Ltd.) **THE NR MARKET NEAR AND BEYOND YEAR 2000.**
11.00	**ARBC Panel Discussion on Rubber Market Prospects.**

Moderator	Dr. Rachmat Soebiapradja (Chairman of the Gapkindo Board of Advisors)	
Panelists	Dr. Viyavood Sinchareonkul	(Thailand)
	Mr. Ng Kok Tee	(Malaysia)
	Mr. Ling Lee Hua	(Singapore)
	Mr. Tjandra Budiarto	(Indonesia)

12.30	Lunch hosted by Gapkindo

* **ARBC** : Asean Rubber Business Club, consisting of rubber producer and trade associations of the ASEAN countries.

* **Dress** : Tropical Formal/Batik

GAPKINDO ANNUAL DINNER

hour	
19.00	Pre-function Cocktail in the Ballroom Foyer, accompanied by Rindik Bamboo Music
19.30	**PANYEMBRANA** Welcome Dance
19.40	Welcome Speech by the Chairman of Gapkindo
19.45	Response Speech by Mr Eric Penot (CIRAD-CP, France), Project Officer of GAPKINDO-ICRAF Smallholder Rubber Agroforestry Project.
19.50	**LEGONG KRATON Dance**
20.00	Gala Dinner
20.30	Musical Entertainment : **AN EVENING WITH ERVINA**
22.30	Closing

* An open bar is available in the Foyer. Drinks are on the house.

* **Dress** : Batik/Casual

ANNEX 7

RAS 2 TRIAL ON STATION IN SEMBAWA OUTLINES.

INTERNATIONAL CENTRE FOR RESEARCH IN AGROFORESTRY

ICRAF

South East Asia Regional Research Programme

Jalan Gunung Batu No. 5, P.O. Box 161,
Bogor 16001, INDONESIA
Phone : (62-251) 315234
Fax : (62-251) 315567
E-mail : icraf-Indonesia@cgnet.com.

Dr. Gede Wibawa
Balai Penelitian Sembawa
0711 361793

Bogor, November 27, 1996

Dear Gede,

As a follow up to our telephone conversation: thanks for the lay-out of the experiment in Sembawa. I'm happy with the overall design, and Hubert agrees as well. The design is simple enough to manage, yet it allows for a comparison of intra- and interspecific competition through the added-rubber plot.

The only questions I have is on the part of the plot which is not marked with your rectangles. It is probably best to keep them as 'internal controls' to check the growth of rubber under no-interference conditions - so they should be included in the rubber growth monitoring scheme. For the sengon and karet plots these no-tree areas are larger than needed, and it may be possible and desirable to have three instead of two rows at each intercrop density. This will bring the number of rubber trees monitored a bit closer to what it is for Duren and Duku.

For the experiment as a whole we need a proper randomization of the intercrop tree species plots, as well as the direction of the split-plots (as on your diagram or in mirror image). Can you send us your ideas on that?

The next step is to develop a more complete protocol for the experiment, which includes the number of field replicates (was it 3 or 4?), the management of intercrops and trees and the type and frequency of measurements - but preparations for tree planting can go ahead.

On your next visit to Bogor it will be good to meet Gregoire Vincent who has recently joined the ORSTOM contingent at ICRAF and who morks on modelling tree-tree interactions in agroforests, starting with damar, but with an interest in rubber agroforests as well.

Best wishes

Meine van Noordwijk

cc DPG,EP,HdF

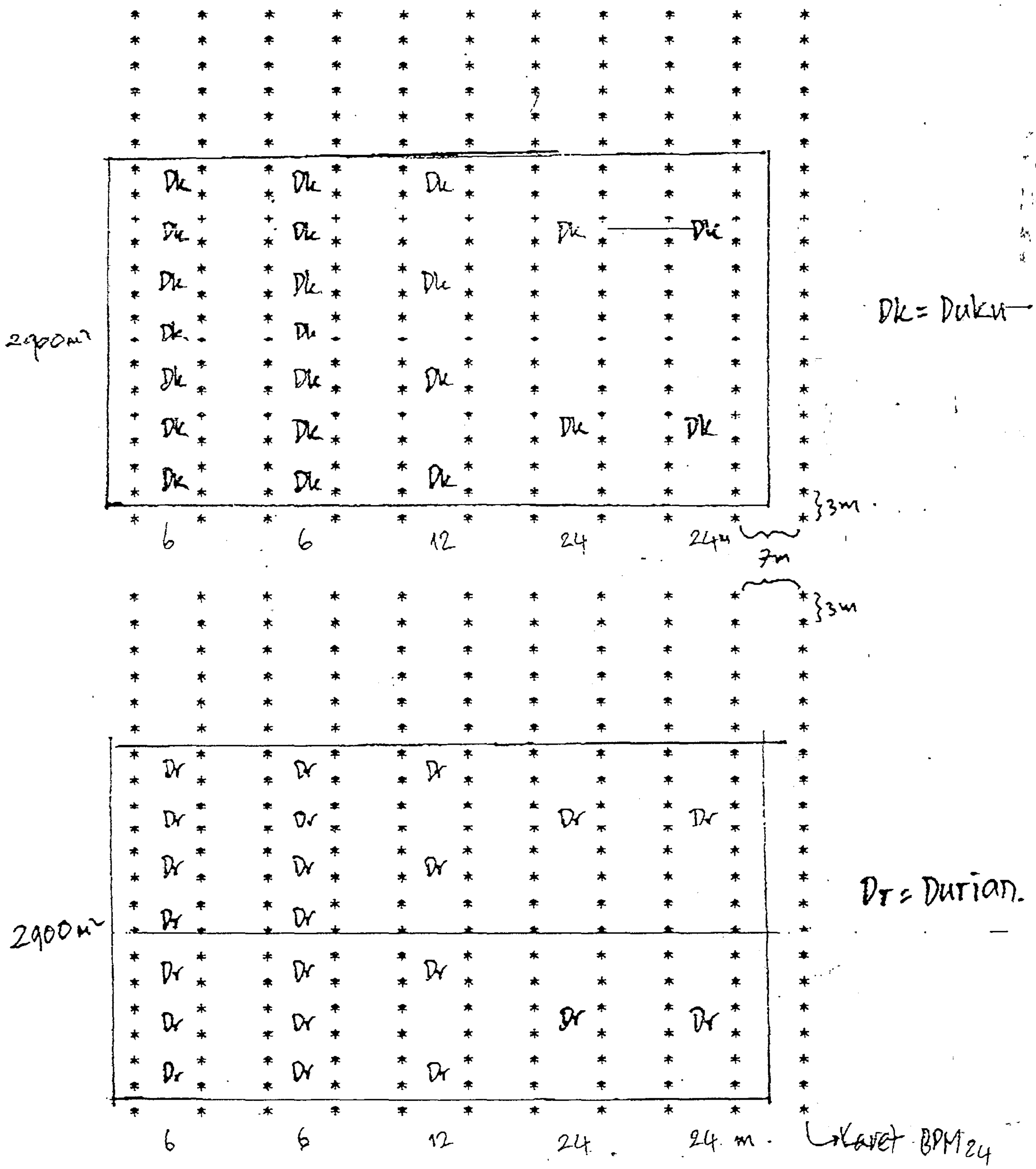
ICRAF | Sent by : YY
Date 27-11-96

-11-1996 15:13 FROM Balai Penelitian Sembawa TO 02513155677 P.01

Dr. Meille & 62 711 361793 312182

This schema will be used in our trial in Sembawa (As discussed earlier) Any comment?

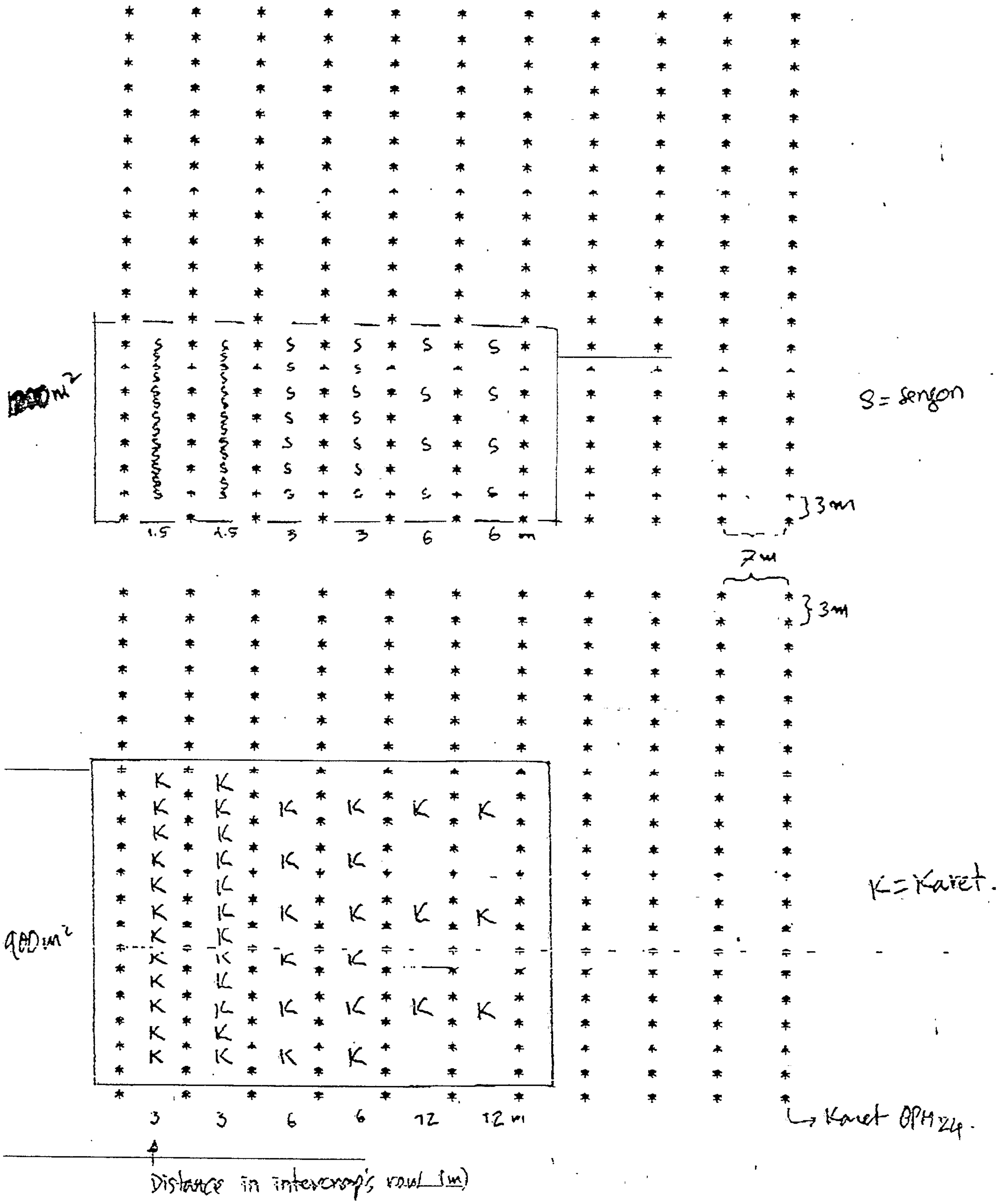
Gede 13/11/96

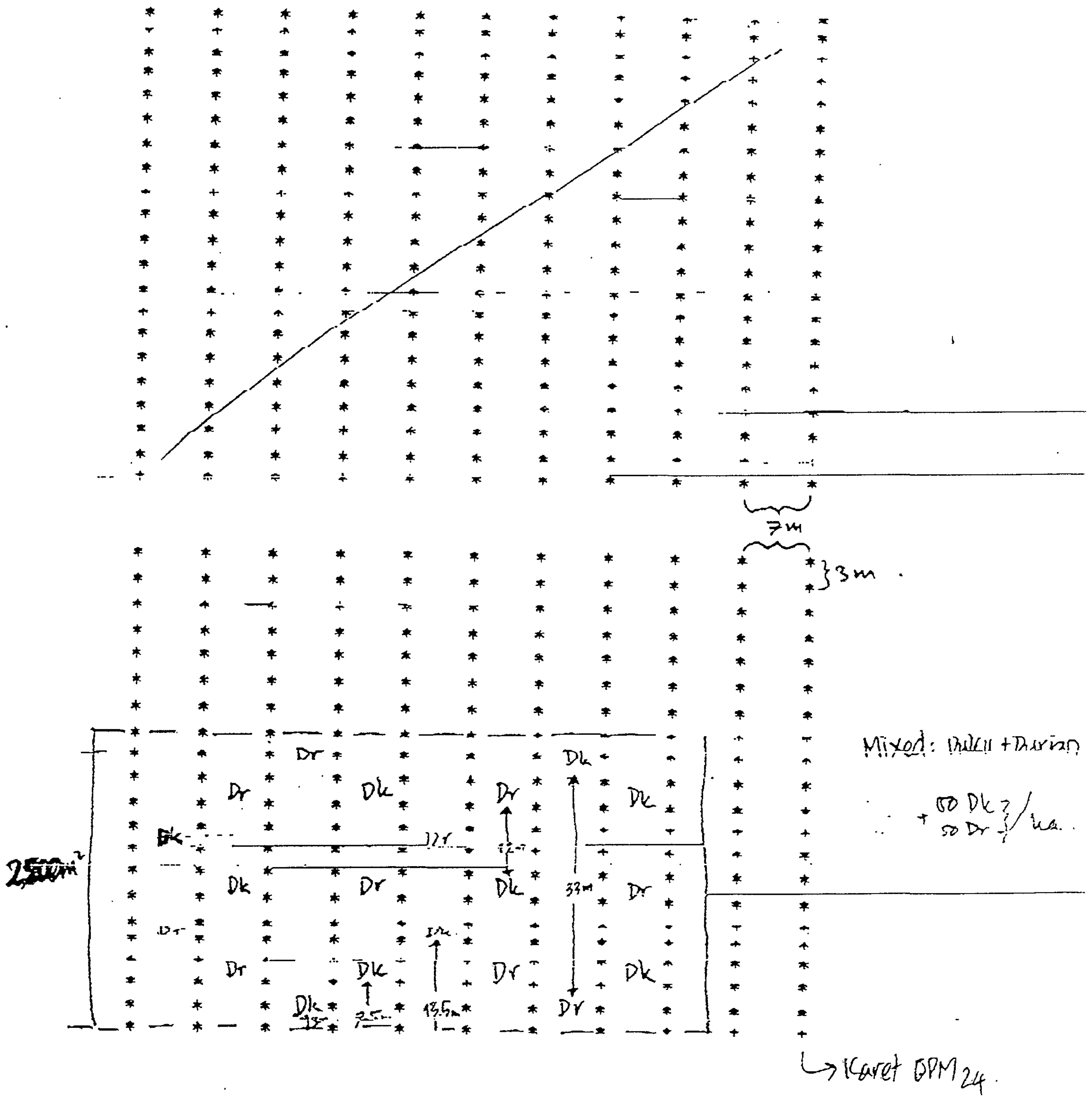


Distance in intercrop's row (m)

RECEIVED
13 NOV 1996

-11-1996 15:14 FROM Balai Penelitian Sembawa TO 02513155677 P.02
62 711 361793 312182




7m
3m
2500m²
Dr
Dk
33m
13.5m
Mixed: Duku + Durian
50 Dk
50 Dr /ha
Karet GPM 24

ANNEX 8

Sujet de thése Benedicte Chambon

Peasant strategy and plantations projects in Indonesia

Context of the research

Indonesia is characterised by its politic stability. Since independence, there were only two presidents : Sukarno (1945-1966) and Suharto (1967 until now). Although Indonesia started to liberalize its economy in the beginning of the 1980's, State is still very present.

In agricultural field, a particularity of this country is that, in the beginning of the century, started a program of directed agricultural colonization in order to reduce its important demographic disparities. Indeed, some islands (Java, Bali and Lombok) are overpopulated. As a consequence, these islands are characterised by intensive cropping (specially foodcops). On the opposite side, agroforestry is an important cropping system (extensive) in the outlying islands : farmers use jungle rubber (unselected rubber seedlings and germplasm). Transmigration consists in selecting families in the overpopulated islands and bringing them in the underexploted islands. When they arrive in the Transmigration centres, settlers are integrated in different agricultural projects.

Since president Suharto is in power, one of the government's priority has been agriculture. Politic development has been based on this activity. At the beginning, foodcropss were the priority. The government particularly wanted Indonesia to become self-sufficient in rice, base of the feeding. Once this objective was reached (in 1984), new national priorities appeared. State then encouraged the development of exporting crops, notably tree crops. This was partly realised with plantation projects.

The N.E.S projects consist in gathering in the same project a « nucleus » (industrial plantation) and a « plasma » mainly constituted by settlers and also by natives (smallholders). « Plasma » is then constituted by individual smallholder plantations (1 or 2 hectares) created and supervised by plantation societies. During three years, farmers are employed as farm workers. After that period, they become landowner. They provide their labour force.
The plantation society (P.T.P) has to clear the site, build infrastructures and houses, establish and maintain plantations until maturity.
The Transmigration Ministry has to choose the families and bring them to the project. Afterwards, they are in charge of the P.T.P. When trees begin to produce, farmers have to start paying back for the plantation establishment charges. For this, P.T.P deducts 25 to 35% from the sale of the rubber because farmers have to sell it all the production.
P.T.P is responsible for plantation development and controls it until the farmers have totally pay back for the charges. It makes sure that farmers use advanced technology. It gives advices to the smallholders and supervises them for maintenance, fertilization, tapping frequency... It provides inputs and, finally controls everything. In this situation, smallholders have only little autonomy : they do not choose crops, nor techniques, nor input quantities, nor suppliers, nor buyers : every thing seems to escape from them.

Parallel to this project, the World Bank started another project to help rubber smallholders : Smallholders Rubber Development Project (S.R.D.P). This project consists in planting and maintaining 38500 hectares of rubber with improved material. In fact, peasants have to gather (10 to 30 families) to establish and maintain the plantation with technical assistance.
This project has been created to help smallholders living in the outlying islands. This means that it was not associated with Transmigration.

Other projects also exist like PKR-GK for instance. Peasants received some intrants and technical assistance for one year and after, they had no more help.

Lastly, in some Transmigration centres created for foodcrops but where this crops were very difficult (specially because of the natural conditions), peasants finaly were allowed to farm tree crops. Farmers then also developed these crops but with no supervision.

Problematic

In this context, and specially in the projects where farmers are supervised (N.E.S, S.R.D.P) we could think that peasant strategies are not very asserted. But according to

several research workers based in Indonesia and in other countries, in those situations, farmers elaborate unexpected strategies which are not always well understood by the supervision structure. It would notably be some strategies to avoid paying back for the plantation or to increase their income to the detriment of trees longevity. These are strategies that we can find specially in the N.E.S. There are certainly others and they must be different from the strategies peasants develop in other projects. We think that in projects like S.R.D.P or PKR-GK where farmers are natives of outlying islands (so used to agroforestry) there must be strategies related to agroforestry. But these strategies may not be well known because even if agroforestry concerns more than 5 millions hectares, it is not recognized enough by local institutions. It would then be interesting to understand why farmers choose to farm only rubber trees, simple agroforestry or complex agroforestry system.
Nevertheless, for the moment, only partial studies have been done on peasant strategies in this kind of projects (P. Levang, 1995 ; A. Gouyon, 1995 ; E. Penot,). This is the reason why we would like to analyse the role played by peasant strategies in these different structures where smallholders, actually, are not always totally in charge of the management of their crops. We would also try to analyse if, according the project and intensity of supervision, strategies are different.

One of the aims of this PhD dissertation is to contribute to a better understanding of these peasant strategies, and to their harmonization with those of the extend service and of the public and private sectors.

For this, we consider, since the beginning, that projects can be assimilated to organizations. Farmers are gathered together in a graded structure with explicit working rules. Every member of the organization has a specific role and they all have the same goal to reach, which is producing agricultural raw materials. It will then be possible to write the central hypothesis of the research : even if some projects are very structured and well regulated, smallholders do not accept to be only considered as some « ways » for the organization to reach its goals. They always keep some autonomy to follow their own strategies. Smallholders can modulate the role that the project gives them : they are, then, actors. The project defined as an organization is the framework more or less constraining for the smallholders behaviour within which many rationalities meet. This can explain opposition (conflicts) or alliance (cooperation) between individuals and groups. Then we suppose that whatever supervision may be, peasants develop strategies. But according to the project, they are different and agroforestry plays an important role in the projects SRDP and PKR-GK.

This PhD dissertation would try to determine the importance of the smallholders autonomy according to the supervision. It would define the way they exploit it that is to say analyse what their strategies are. We would specially focus on peasants strategies related to agroforestry in SRDP and PKR-GK. We would also try to understand which their origin and determinings are.

Theoretical basis

For this work we chose a sociological approach, and we consider that the social actors (smallholders) are in the centre of the study. Two different approaches are needed.

One of the strategic analysis postulate, which constitutes our main hypothesis, is that the actors in the organisations always keep some liberty. This liberty can be evaluated by all the informal practices they develop in the projects. This relative liberty of the actors is linked with their power or, in other words with their ability to direct someone's action. This liberty (and therefor the smallholders power) will be higher if they can or/and know how to keep their behaviour unforeseeable for the others. It is so necessary to locate the power relationships that exist in the project. It is also important to identify the smallholders relationships with other actors through the network analysis (a network is the system of social relationships that smallholders develop in and outside the project).

A second approach is centred on the farmers identity. Smallholders have varied origins. Some were there when the project took place, others came from overpopulated islands ; they belong to different ethnic groups, have varied social origins, are used to different cropping systems... It is therefore important to notice all the common cultural marks which differentiate a group from another, and all the things that make one individual or group think that he is different from another. We believe that in this case, identity must be particularly asserted since people become aware of their own identity when they meet another. Individual identity is closely linked with the way they represent themselves, the others and the situation. Moreover, according to D. Jodelet (1989), one of the social representations functions is to direct the actors behaviour, and so, their strategies. In other words, farmers rationality partly depends on their social representations, and specially on the way they perceive their socio-economic situation and the local context. Smallholders rationality can also be defined according to their aims, which depend on the means they can mobilize to reach these goals. Rationality is lastly defined according to the values and norms of their society, and according to their past experiences. Through this second approach we would like to understand smallholders rationality in their context, and the way they make their decisions.

Methodology

Our work will start with a bibliographic research in France and in Indonesia. This would strengthen the theoretical basis of this study. We need information about the different projects, N.E.S, SRDP, PKR-GK projects, and about Transmigration's centres because there is not very much in France. We will also meet French research workers, those from I.C.R.A.F and Indonesian persons in charge of these projects. This would allow us to refine our problematic.

Afterwards, we will observe smallholders practices : daily cultural practices and practices linked with their professional activity. During this time, we will meet the smallholders we will focus on later. We will also visit farmers plots.

Most of the information we need will be collected with a survey. In order to measure the projects influence on the peasants strategy, we will analyse these strategies in four situations :

1) smallholders without supervision (Transmigration centre)
2) smallholders with little supervision (PKR-GK projects)
3) smallholders with more supervisory staff and mainly natives of the outlying islands (SRDP project)
4) smallholders with a large supervisory staff and mainly natives of overpopulated islands (N.E.S project).

In total, we will visit 180 farms : 80 N.E.S (40 in Jambi, Sumatra and 40 in Sambas, West Kalimantan)
40 SRDP (20 in Jambi, Sumatra and 20 in West Kalimantan)
30 PKR-GK (West Kalimantan)
30 Transmigration centre (Sintang, West Kalimantan).
We will first analyse the peasants strategies in the different structures and we will then compare them.

Timetable

Works	Duration
Bibliography and administrative formalities (France)	6 month
Intensive language training (Indonesia)	5 weeks
Bibliography and meeting with different partners (Indonesia)	3 month
Observation (Indonesia)	3 month
Surveys (Indonesia)	6 month
Data processing (Indonesia)	9 month
PhD dissertation redaction (France)	8 month

ANNEX 9

Sujet de thése Franz Gaetzwiller

Research proposal
Humboldt Universität zu Berlin, Chair: Resource economics, Prof. Dr. K. Hagedorn
In collaboration with:
International Center for Research in Agroforestry (ICRAF), Indonesia

The Economic Value of Ecology in Complex Agroforestry Systems in Indonesia

Introduction

Indonesia's biodiversity is the country 's greatest natural resource. Many sectors of the nation's economy are dependent directly or indirectly on the diversity of the natural and semi-natural ecosystems and the environmental functions they protect. Conservation of biodiversity is crucial to the sustainability of sectors as diverse as forestry, agriculture and fisheries, health care, science, industry and tourism.(Biodiverstiy Action Plan for Indonesia, 1991)

In Indonesia the annual depletion of forests is estimated to be 1.3 mio ha (3.7 %).(SFDP, 1994). Apart from contributing to the greenhouse effect, deforestation disrupts the hydrology of watersheds, decreases biodiversity, contributes to soil erosion and local dwellers loose an important resource from which commodities for subsistence and commerce are derived (de Jong, 1993). Furthermore the environmental functions of complex agroforest-ecosystems far excede the extraction of only one commodity, e.g. timber.

In development planning, very often, the total economic value of natural and/or semi-natural forest environments are seriously underevaluated. This is, because only a few commodity values from the forest are taken into account (e.g. rubber or timber). One result of this underevaluation is that tropical forest environments are cleared and substituted by monocropping systems, like e.g. monospecific stands of rubber, which are said to be more profitable than "unproductive" diversity of natural resources.

Since generations the indigenous people (e.g. the Land-Dayak in West Kalimantan) have developed land-management systems which have been sustainable[1] under the conditions of an ecologically balanced socio-economic and natural environment.(Momberg, 1993) Some of these are: TEMBAWANG (mixed fruit forest gardens), KEBUN KARET (rubber forests with other species), BAWAS TUA (old growth secondary forest), or LADANG (upland rice after slash and burn) and SAWAH (wet-rice cultivation).

Mainly because of increasing demographic and economic pressures (West Kalimantan) some of the traditional land-use practices , such as slash and burn, cannot any longer be regarded as economically and ecologically appropriate forms of land-use. However, many farmers still practice these traditional farming methods as they have neither alternatives, nor access to more productive technology . In West Kalimantan 46% (9.2 mio ha, 1992) of the forest area are categorized as "limited production" and "production" forests. Development has focused on land-use management in this area in order to improve the relations between local communities and their forest environment. (SFDP, 1994).However, this means modifying current systems and developing new forms of land-management in particular agroforestry, in order to reach the level of present day needs.

[1] They sustain the natural resource base and simultanously sustain a production level which can fulfill the income needs of the farm household.

Complex agroforestry systems as income and environment improving land management systems - the rubber agroforestry ecosystem.

Rubber agroforests are complex agroforestry systems with rubber as the main cash providing component and timber, fruits, rattan, and other non-timber forest products as secondary outputs of the system.(Gouyon et al. 1995). They cover over 2 million ha in Sumatra and Kalimantan and are probably the most widespread complex agroforestry system in Indonesia. The quality and productivity of such rubber (local varieties), is very low with 300-600 kg/ha compared to sole stands of improved (high yielding and pest resistent) planting material :1300-1800 kg/ha. (Penot,1994)

Rubber is, after plywood, Indonesia's second largest agricultural export product. The smallholder sector contributes 84% to the total cropped area and 72% to the total production.The majority of the smallholders are still not involved in government development projects. Mainly because of the high implementation costs of these projects less than 15% of the smallholders have been effected by rubber development projects.(A.Gouyon, 1989). Some of the programs of these development schemes are: NES/PIR[2], PRTPE[3], SRDP/TCSDP[4], and TCSSP[5].

The Smallholder Rubber Agroforestry Project (ICRAF) has the objectives of increasing the productivity of these systems by the integration of this improved rubber planting material. Simultanously diverse ecological features of the system are maintained to an extent as close as possible to that of the original "jungle rubber"-system by allowing the growth of fruit trees, timber trees and other species. (Penot, 1994) The incremental benefits provided by these ecological functions (goods and services) of the complex environmental characteristics of this agroforestry systems can be considerable. In development planing and project management the incorporation of these ecological benefits may make the decisive difference between the choice of land management systems with different degrees of biodiversity.

Complex rubber agroforestry system may be one of the most favourable among two general options to solve land-use conflicts[6] which have evolved mainly as a result of growing demographic and economic pressures:

1 . The segregation of nature and agriculture (intensifying agricultural production on a relatively small part of land leaving relatively large parts of land for nature), e.g.: intensive agriculture + nature reserves. (van Noordwijk. 1995)

[2] NES= Nucleus Estate and Smallholder Program (PIR in Indonesian).

[3] PRTPE= Project for Replanting, Rehabilitation and Extension of Export Crops (1968-79).

[4] SRDP/TCSDP= Smallholder Development Program (1979-1988), implemented in the Tree Crop Smallholders Development Program (TCSDP) from 1988 until now.

[5] TCSSP is identical in terms of implementation with TCSDP but different donor since 1993.

[6] Conflicts between human use of biotic resources ("agriculture" in its widest sense) and biodiversity ("nature" in its widest sense). (v. Noordwijk, v. Schaik, de Foresta, Tomich)

2. The integration of nature and agriculture (production systems which allow sufficient agricultural production while ensuring conservation of the biodiversity of the natural system), e,g.: rubber and other agroforestry systems.(van Noordwijk et al.1995)

The segregation-integration discussion will also depend on the completeness of the valuation method applied. Conventional, reductionist valuation methods are likely to support the segregation option. Whereas a more holoistic evaluation of all environmental goods and services of a land management system may give more arguments in favour of the integration option.

Hypotheses

Hypothesis 1: Complex Agroforestry Systems are very flexible systems in terms of species composition and management as they show different ecological features in different areas. They are therefore an excellent object of study in order to identify the economical importance of integrating diverse ecological features into agricultural cropping systems.

Hypothesis 2: The entire value of rubber agroforest ecosystems is higher if all environmental goods and services they provide are taken into account. If all functions of the system are taken into account it would prove that the sustainable use of these diverse agroforest ecosystems is not only environmentally sound but also economically profitable.

Therefore, before deciding on the use of a certain land-management system, a more complete account of all ecological and socio-economic values should be worked out in order to contribute to a more balanced development planning and decision-making.

Hypothesis 3: Cropping systems, like complex rubber agroforestry systems are close to the traditional farming practices of the local communities in terms of strategies and indigenous knowledge, and also meet the physical and climatical conditions of the tropical environment.

Hypothesis 4: The integration of ecology and economy ("nature" and "agriculture") by rubber agroforestry systems will lead to the development of biophysically and economically stable farming systems. These farming systems can sustain[7] a certain level of biodiversity as well as a higher level of agricultural productivity compared to monocropping systems.

Hypothesis 5: The "integration-option " can be of higher economic value than the "segregation-option" as the overall productivity per hectare of an agroforest with several different crop yields and benefits from environmental functions has potentials of being higher than that of a monospecific plantation (the Land Equivalent Ratio is higher than 1)[8].

Hypothesis 6: A comparison between the rubber agroforestry system and the monocultural system should be based on this productivity comparison (Hypothesis 5) in the short term and the sustainability of this productivity in the long run.

Hypothesis 7: Taking all environmental functions which the complex agroforestry system provides into account, the complex Rubber Agroforestry System is the most appropriate and cost efficient alternative (among other rubber systems) which meets the farmer´s needs and contibutes to the stability of the vulnerable tropical ecology.

Objectives

The aim of this study is to assess the economic value of the ecology[9] of complex agroforestry systems. This will be done by assessing the value of the environmental functions of the specific agroforestry-ecosystems.

A list of environmental characteristics (parameters) and an inventory of all species living within the system will be established in order to identify as much as possible environmental functions which are provided by the agro-ecosystem. A list of environmental functions for each agroforestry system will be established.

A more complete total value of the agro-ecosystem can be calculated by this and more reliable data can be provided for development planning. By calculating the functional value of these land use systems the conventional Cost-Benefit Analysis will be expanded and thereby more completed. From this conclusions can be drawn concerning the optimum degree of ecological diversity in different agricultural land management systems.

The main objective of the study will be to assess the functional value[10] of the system´s ecology as well as the identification of the system´s intangible benefits.

Indigenous farming practices are one existing link between the functions of species diversity and the farmer´s regulating activities. Therefore these indigenous management practices have to be studied closely. In order to receive information about economic values of the agro-ecosystem´s functions, detailed knowledge of the indigenous "adat" law and traditional common property rights, is essential. Communal management of resources has the advantage of reducing transaction costs. The evolution of rules and self-regulatory mechanisms within a group has significance for sustainability and survival. (Berkes and Folke 1994)

The key question is: Which are (among monospecific systems and more diverse agroforestry systems) the trade-offs between: 1. increasing income needs and 2. the limited ecological carrying capacity[11] of the natural environment under different population densities?

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[7] Sustainability, meaning the maintainance of production from the natural resource base on which this production depends.

[8] When the Land Equivilant Ratio is higher than 1, there is a production advantage from the crop combination compared to that of the sole stand.

[9] Ecology is refered to here as the interrelations between: 1.: The (agro-) ecosystems components and its functional contribution to 2: Human needs and activities.

[10] The functional value refers to the value of the environmental goods and services the system provides to man.(de Groot 1992)

[11] In this text the ecological carrying capacity is defined as the (limited) capacity of the ecosystem to provide goods and services for man while sustaining its own internal ecological functions.

The research will be carried out in West Kalimantan, District of Sanggau, through the study of ecological aspects of different agroforestry - ecosystems: RAS (Rubber Agroforestry Systems), traditional agroforest environments ("hutan karet" = jungle rubber).

Finally the aim of this study is to give recommandations with emphasis on ecological and economical issues for the development and management of sustainable rubber agroforestry systems in production forest areas in West Kalimantan, Indonesia.

Methodology

Environmental function evaluation can be seen as an attempt to combine conservation evaluation (the ethical approach) and land use evaluation (the utilitarian approach) in order to provide a relatively objective reference system for measuring the importance of natural ecosystems to human welfare. (de Groot, 1992 .[12])

The systems view of the human/environmental relationship is considered for a better understanding of the environmental function evaluation concept:
„The structure and the functions of the ecosystem is sustained by synergistic feedbacks between human societies and their environment: The physical and biological environment places basic physical constraints on the growth and development of the human subsystem. ...The human subsystem in turn actively modifies its physical and biological environment." (Berkes, F. and Folke, C. 1994 .[13])
Although the need for sustainable development in development planning is accepted increasingly, the importance of environmental functions and values of natural and/or semi-natural ecosystems is still not being given adequate attention. ..."In spite of the growing knowledge about the importance of natural ecosystems to human welfare, it seems difficult for man to translate this knowledge into concrete actions...and to implement the concept of sustainable development into practice."(de Groot, 1992).

In spite all controversies the basic underlying principle should be clear : the need for harmony between man and nature. The function evaluation concept, gives a more specific definition of the concept of sustainable development and provides development planers and decision makers with a useful methodology to put the goal of sustainable development into action.

The basic idea of the function-evaluation is that the human use of environmental functions for the satisfaction of human needs should remain within the carrying capacity of a given ecosystem and not destroy its functioning for future generations. Functioning agro-ecosystems are the guarantee for sustainable economicall development.

As both, environmental functions and human activities/needs are interactively connected (see „the systems view"), sustainable development has to be understood as ecological sustainability, which has to be maintained in order to enable economic development. Economic development should take place within the limits of the carrying capacity of ecosystems, which provide the prerequisites (environmental goods and services) for just this development.

Again an interactive dependency between nature's health (proper ecosystem functioning for the provision of environmental goods and services) and human wealth (achieved through economic development) has to be seen. However, the protagonists in the interactive play of economic and natural forces have changed: not economy dictates development paths but ecological constraints do.

Environmental functions are defined as the capability of natural processes and components (characteristics) of an ecosystem to provide goods and services for the satisfaction of human needs. The environmental function evaluation method developed by De Groot meets the needs for a comprehensive and appliable method of evaluation in development projects, land use planning and decision making.

A collaborative participatory research approach is chosen for this study. Researcher and farmers are partners in this research process and continously collaborate in the project activities. (Ch.Okali et al.1994)

Field surveys (incl. transect walks with the farmers), observations and interviews with the farmers will be carried out in order to identify the structural composition of each system and assess the present stock of resources.

An inventory of botanical species for each agro-ecosystem will be established on the basis of the square field method (Küchler & Zonneveld, 1988). By the use of this method all plants occuring in a sample square of a given size (1-1000 sqm) in a representative part of the vegetation, can be listed.

Farmer's strategies and management objectives will be described by observation and by interviewing the farmers and household members. During the interviews the farmers priorities in decision-making and their economic/ecological worldview and their needs, are discovered in order to choose the appropriate valuation method.

Central for the evaluation of intangible costs and benefits are interviews with key informants to receive information about specific environmental regulations and rules determined by the indigenous "adat" law and common property rights.

Different strategies to value environmental benefits will be used, where appropriate (Gittinger, 1982): Direct economic returns from the system's commodities (latex, fruits,rice,...) and measurement of environmental effects which are reflected through a change in economic production. Indirect calculations (opportunity costs, cost efficiency) and estimates and assessment/description of intangible benefits.

The total economic value of the studied agroforestry system's ecology will be measured by:
Recording their monetary returns to the farm household: The economic returns represent the total of products which can be harvested in a sustainable way either for self-consumption or for sale. In order to calculate monetary values of environmental goods and services market prices aswell as shadow prices will be attributed by applying different valuation methods (e.g.: maintainance cost, mitigation cost, willingness

12 De Groot, Rudolf S. 1992. Functions of Nature. Wolters-Noordoff
13 Berkes, F. & Folke, C. 1994. Investing in Cultural Capital for Sustainable Development. In: AnnMari Jansson et al. (eds), Investing in

to pay, etc.) (de Groot, 1992). Preparatory work has been done by ICRAF researchers here, so that some secondary data for these calculations are available. Intangible benefits also reflect true economic values. In order to capture intangible benefits the conventional cost-benefit analysis will be modified to a cost-effectiveness analysis[14]. In addition intangible values will be described and verbally mentioned.

The function-evaluation-method is the assessment method used in this research which incorporates different valuation practices. It will be applied in order to assess the economic value of environmental functions (goods and services) of the agroforestry-ecosystems. During the evaluation-procedure of the system's environmental functions, two main steps will be taken:

1. Ecological assessment of environmental functions: A checklist of environmental functions for RAS and the other agro-ecosystems will be developed. These functions are characteristic for each agroecosystem and depend on the specific cultural/socio-economic setting and the management objectives.

2. Socioeconomic valuation of environmental functions: As the environmental functions are diverse, the socio-economic value of one function may be no appropriate parameter of the value of other functions. Therefore, as mentioned above, a multiplicity of ways to assess environmental values will be applied.

A function evaluation- matrix will be developed in which different types of values can be attributed to the environmetal functions of the specific agroforestry-ecosystems. From this matrix the total socioeconomic value of a given area can be calculated. The total value of the environmental goods and services are described by different values which are described and quantified by different parameters of which monetary units are only one element. Quantification in monetary units is seen as an addition to the intrinsic and intangible values of the system.

Primary and secondary data which are collected will be processed by using the appropriate and available computer programs. This will be Excell (IBM) and/or SPSS, Claris Works, Word (Macintosh).

Outputs

The findings of the proposed study can be used by the farmers themselves (a summary of the dissertation will be translated into "bahasa Indonesia" and "bahasa Dayak". The results will also be illustrated by drawings and photos). The farmers receive scientific data about the total economic value of the agroforest-ecosystem's environmental functions. Such information may be used to support them to make decisions for their own household and livelihood management.

This study will give a more holoistic picture of the analysed systems from an ecological economics perspective. The study will help to define the economic value, importance and advantages of integrating diverse ecological features into different land-management systems by assessing their value especially in terms of their functional contribution to the household economy.

[14]Determination on the present worth basis of the least expensive alternative combination of tangible costs that will realize essentially the same intangible benefits (=least-cost combination).

Because many functions of ecosystems cannot be expressed in monetary units traditional Cost-Benefit Analysis inadequately reflects the true environmental and socio-economic value of natural resources and agro-ecosytems.

Information obout the benefits of environmental functions (goods and services) and costs of the loss of these goods and services which are provided by the environment, are essential for development projects which hereby receive ecological guidelines and data to refine existing incomplete Cost-Benefit-Analysis.

The function-evaluation-system used here, will help to translate ecological data into useful information for local environmental and economical development planning. It will become clear that diverse agro-ecosystems are more valuable than it would be calculated by the extraction of only some commodities, because the unifying concept for ecology and economics used here (by the application of the environmental function-evaluation-method) is probably a more complete way of measuring the total value of different land management systems. And by this helps to keep the delicate balance between environmental health and human wealth.

Development planers and extension agents may aswell profit from the findings. They will receive information about ecologicall and economicall benefits of complex Rubber Agroforestry Systems in a specific ecological and socio-economic environment. These information will allow them to reach more smallholders with appropriate development efforts, incentives, and extension service.

Last but far from least, the results of the study can be used for development planing, and decision makers receive guidlines for the implementation of sustainable cropping systems which meet the cash needs of the farmers, are close to their present farming strategies and simultanously cotribute to the stabilization of the vulnerable tropical natural environment.

References:

Berkes, F. and Folke,C. 1994. Investing in Cultural Capital. In:AnnMari Jansson et al. (eds.)1994. Investing in Natural Capital-The Ecological Economics Approach to Sustainability,International Society for Ecological Economics, Island Press

Biodiverstiy Action Plan for Indonesia, Final Draft, 1991

Cleary, M., Eaton, P. 1992. Borneo. Change and Development. Oxford University Press.

Constanza, Robert(Ed.) 1991. Ecological Economics. The Science and Management of Sustainability. Columbia University Press, New York

de Groot, Rudolf S., 1994. Environmental Functions and the economic value of natural ecosystems. In: Investing in Natural Capital-The Ecological Economics Approach to Sustainability, Ed. by: A.M.Jansson, M.Hammer, C.Folke, R.Costanza. (International Society for Ecological Economics)

de Groot, Rudolf S. 1992. Functions of Nature. Evaluation of Nature in Environmental Planning, Management and Decision Making. Groningen, The Netherlands: Wolters Nordhoff BV.

de Groot, Rudolf S. 1987. Environmental Functions as a Unifying Concept for Ecology and Economics. *The Environmentalist*, Vol.7, No.2, 105-109

de Jong, Wil 1994. Dayak Forest Management Research Project. Progress Report. SFDP

Pontianak/Sanggau

de Jong, Wil 1992. Forest Management Practices of Dayaks in West Kalimantan. SFDP Pontianak/Sanggau.

Gatzweiler, F.W., 1993. Possibilities of an Ecological Rubber Production in Malaysia. Research Study, ASA -Program, Carl Duisberg Gesellschaft, Berlin.

Gatzweiler, F.W., 1995. Socio-Economic Study of an Agroforestry System: The Case of Malay Home-gardens in a Malaysian Village (M.Sc. thesis), Humboldt Universität zu Berlin, Fachgebiet: Ressourcenökonomie.

Geertz, Clifford 1963. Agricultural Involution. The Process of Eclogical Change in Indonesia. University of California Press

Gittinger, J.Price 1982. Economic Analysis of Agricultural Projects. Johns Hopkins University Press Baltimore/London

Gouyon, A. , de Foresta, Levang 1995. Does Jungle Rubber Deserve its Name? An analysis of Rubber Agroforestry Systems in SE-Sumatra.Unpublished Paper

Gouyon, A., Sultoni, M. , Nancy, C. 1990. Rubber Smallholders in Indonesia. Proposed Contribution to a Country Report. Paper submitted to the Departmen Perdagangan, Indonesia.

Gouyon, A. , Nancy, C. 1989. Increasing the Productivity of Rubber Smallholders in Indonesia. Paper presented at the Rubber Growers Conference , RRIM, Malacca, Malaysia.

Gouyon, A. 1991. Farming and Social Changes in South Sumatra: An Historical Perspective.

Küchler, A.W. & Zonneveld, I.S. 1988. Vegetation mapping. Dodrecht. Netherlands.

Michon,G. , Mary,F. , Bompard, J. 1986. Multistoried agroforestry garden system in West Sumatra, Indonesia. in: Agroforestry Systems 4: 315-338

Momberg, Frank 1993. Indigenous knowledge systems. Potentials of social forest development. TUBerlin. Berliner Beiträge zu Umwelt und Entwicklung.

Michon, G. , Mary, F. 1987. When agroforests drive back natural forests: A socio-economic analysis of a rice agroforest system in Sumatra

v. Noordvijk, v. Schaik, de Foresta, Tomich 1995. Segregate or Integrate Nature and Agriculture for Biodiversity Conservation. ICRAF SE-Asia

Okali, Christine, Sumberg, James, Farrington, John 1994. Farmer Participatory Research. Rhetoric and Reality.Overseas Development Institute, London

Penot, E. 1994. Improving the Productivity of Smallholder Agroforestry Systems: Sustainable Alternatives. Working Paper May 1994.

Penot, E., Budiman, A., de Foresta, H., Tomich, T. 1994. Integrated Rubber Agroforestry for the Future of Smallholder Rubber in Indonesia. Paper presented to the Rubber National Conference, IRRI, Medan, Indonesia

Repetto, Robert 1996. "Die Entwaldung der Tropen: Ein ökonomischer Fehlschlag."&"Die Bewertung natürlicher Ressorcen." In: Spektrum der Wissenschaft. Dossier: Dritte Welt.

Social Forestry Development Project (SFDP) September1994. Project description, Sanggau, Borneo

Sullivan, Gregory M., Huke, Susan M., Fox, Jefferson M.,(Ed.) 1992. Financial and Economic Analysis of Agroforestry Systems. Proceedings of a workshop Honolulu, Hawaii, USA, July1991. Nitogen Fixing Tree Association, Hawaii.

van den Bergh, Jeroen C.J.M. & van der Straaten, Jan,1994.Toward Sustainable Development-Concepts, Methods, and Policy. International Society for Ecological Economics. Island Press.

World Bank Country Study 1990. Indonesia. Sustainable Development of Forests, Land and Water.

World Bank Country Study 1994. Indonesia. Environment and Development

World Bank Country Study 1994. Indonesia. Sustaining Development

World Bank 1994. Macroeconomic Policies, Crises, and Long-Term Growth in Indonesia 1965-90.

ANNEX 10

Biophysical interactions experimentation in Jambi Outlines.

Appendix 3. Biophysical interactions (above and below ground) between components of rubber agroforestry in Indonesia

3.2.1 Experiments

Experiment 1. Genotype x management interactions

Hypotheses:

Primary

The growth of clonal rubber is depressed to a greater extent than the growth of local rubber seedlings in the presence of high weed competition.

The growth of clonal rubber is increased to a greater extent than the growth of local rubber seedlings in the presence of low weed competition.

Secondary

Increased intensity of weeding within the rubber row will not affect the regenerative capacity of the useful secondary forest tree species.

I.e. Constant disturbance will not preclude the establishment of tree growth forms as a result of increasing frequency of other growth forms such as grasses or ferns.

Treatments

genotype;

1. clone PB 260
2. Local jungle rubber seedlings

Management;

1. "High" weeding level: low intensity of competition from weeds and regenerating secondary forest species, representing optimal conditions for growth of clonal rubber. Weeding nine times per year, 1m on either side of the trees along the whole length of the rubber tree row.
2. "Low" weeding level: high intensity of competition from weeds and regenerating secondary forest species, approximating jungle rubber conditions. Weeding four times per year, 1m on either side of the trees along the whole length of the rubber tree row.

Layout

Experimental area: 0.62 ha. Muara Buat village.

Topography: 2 hills, average slope 60%. Each hill forms one replicate.

Blocks: each hill is divided into 3 blocks;

hill crest

lower slope, aspect WSW (west-south-west)

lower slope, aspect ESE (east-south-east)

Plots: each block is divided into 4 plots and a weeding treatment assigned randomly to a pair of adjacent plots. To each plot within this pair, each rubber genotype will be assigned randomly. Plot size will be 18 trees in replicate (hill) 1, 9 trees on replicat (hill) 2.

Thus in total:

2 replicates

6 blocks

4 treatments
48 plots

Measurements
Rubber growth (every 3 months, on all trees);
stem height
stem diameter (at 10 cm above graft or stem)
number of whorls
number of leaves per whorl
(Seedlings: as above, plus height on main stem of shoot initiation)

Monitoring of growth forms of vegetation
Initial mapping of distinct patches/communities of vegetation. Within these a 1m square quadrate will be used to record cover, mean and maximum height of dominant growth forms of each according to the following classification:
Trees: seedlings, resprouting cut stems
Other woody forms: self supporting shrubs, climbers
Herbs: monocotyledons (grasses, sedges, gingers)
dicotyledons (self supporting, climbers)
Ferns: self supporting, climbers

Also a specific comparison will be made between vegetation in the weeded row and the non weeded interrow area, using permanent 1m sq quadrats, 2 placed randomly in each defined area, in each plot. These will be monitored immediately before weeding is carried out in each treatment.

Quantitative data on biomass will be obtained by harvesting one 1m sq quadrats (from row and interrow) randomly from each plot, immediately before weeding. Samples will be divided into growth form, fresh weights will be obtained in the field, samples air dried and later oven dried to constant weight, and dry weights thus obtained for each growth form.

Biomass results will be compared with the more qualitative growth form composition data.

Experiment 2: Management x site interactions
Hypotheses
Main hypothesis
Increasing intensity of weeding within the rubber row will result in greater growth of rubber due to an decrease in intensity of above- and below-ground competition from regenerating secondary forest species.

Secondary hypotheses
1. As in experiment 1
2. Increased intensity of weeding only within the row will not affect the susceptibility to invasion by Imperata.
3. A leguminous cover crop used in the inter-row area will be less competitive in terms of rubber growth than secondary forest regrowth in the inter-row.

Treatments

Genotype; clonal rubber only, clone PB 260

Management; three weeding intensity levels and a control

1. control; Prescribed "standard" plantation management conditions (TCSDP= Tree-Crop-Smallholder-Development project; a project of the World Bank), using leguminous cover crop (LCC), with a "high" weeding level: low intensity of competition from weeds and regenerating secondary forest species, representing optimal conditions for growth of clonal rubber.
2. "Low" weeding level (4 times a year on the row weeding): high intensity of competition from weeds and regenerating secondary forest species, approximating jungle rubber conditions
3. "Intermediate" weeding level (6 times a year on the row weeding): intermediate intensity of competition from weeds and regenerating secondary forest species, approximating the theoretically most feasible trade off between jungle rubber and plantation conditions in terms of rubber growth and labour investment.
4. "High" weeding level (9 times a year on the row weeding): low intensity of competition from weeds and regenerating secondary forest species, representing optimal conditions for growth of clonal rubber.

Layout

Replicates: 5 replicates in 4 farmers fields in Rantau Pandan and Muara Buat villages. Average size of replications is 0.5 ha.

Topography: steeply sloping, representative of piedmont area of Sumatra.

Plots: Each replicate or block is divided into 4 plots along the slope, with each plot extending from top to bottom of slope. A weeding treatment is assigned randomly to each plot. Plot size is on average 40 trees per plot.

It's a randomized block system, where each field forms at least one block (because of the existence of differences in farmer management and differences in fields), with in total 5 blocks, 4 treatments, 20 plots.

Testing main hypothesis

Measurements;

rubber growth (every 3 months, on sample of 30 trees):

stem height

stem diameter (at 10cm above graft or stem)

number of whorls

Testing hypotheses 1 & 2

A specific comparison will be made between vegetation in the weeded row and the non weeded interrow area, using permanent 1m sq quadrats, 2 placed randomly in each defined area, in each plot. These will be monitored immediately before weeding is carried out in each treatment.

Quantitative data on biomass will be obtained by harvesting one 1m sq quadrate (from row and interrow) randomly from each plot, every 3 months, immediately before weeding. Samples will be divided into growth form, fresh weights will be obtained in the field, samples air dried and later oven dried to constant weight, and dry weights thus obtained for each growth form.

Biomass results will be compared with the more qualitative growth form composition data.

Testing hypothesis 3
Planned comparison between treatments 1 and 4 above, over all blocks.

Experiment 3: Management X belowground interactions

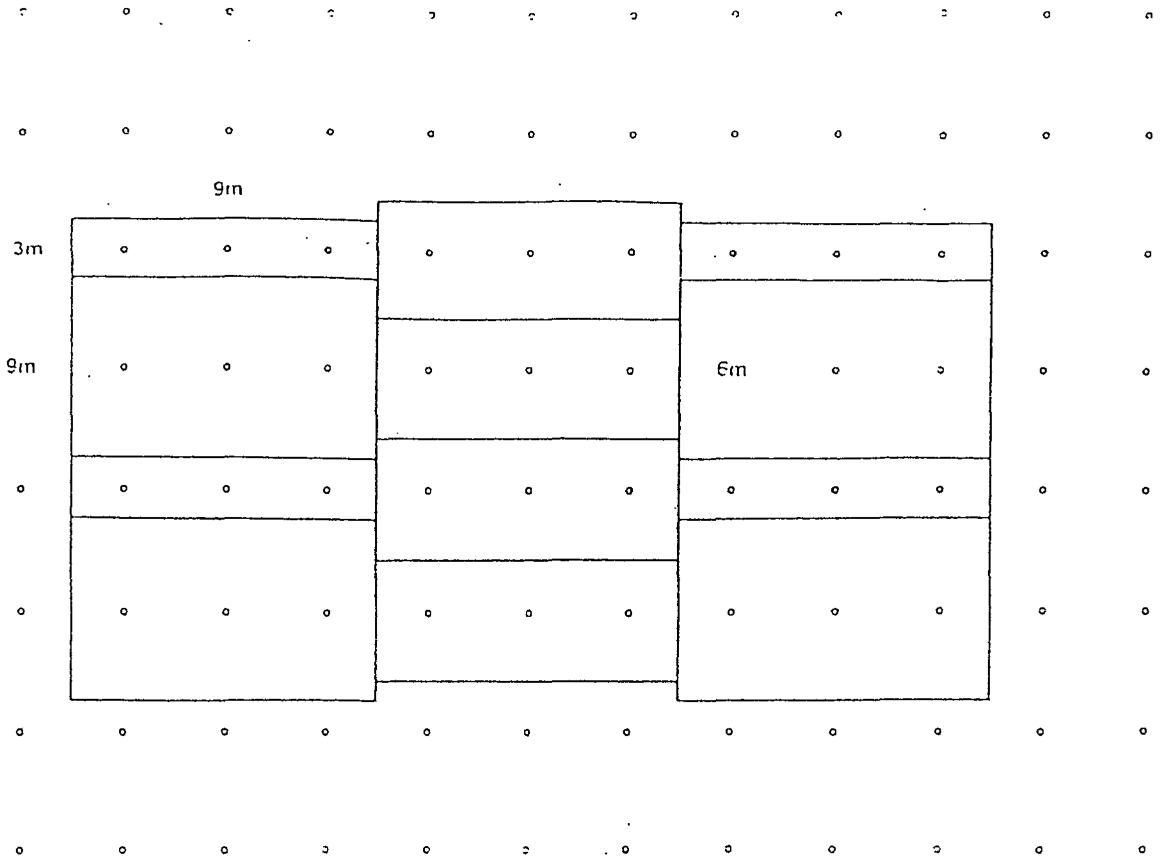
Hypothesis
Main hypothesis: Increasing intensity of weeding within the rubber row will result in greater growth of rubber due to a decrease in intensity of above- and below-ground competition from regenerating secondary forest species.

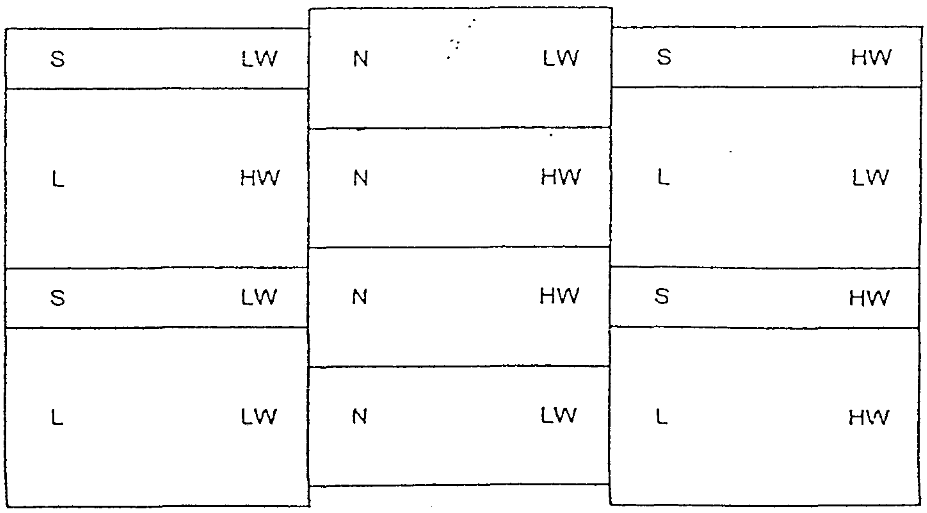
Secondary hypothesis:
1. With decreasing soil volume rubber growth will decrease
2. With increasing weeding intensities rubbergrowth will be increasing

Treatments
1. Soil volume per tree:
(Surface areas of available soil volume are quoted here, as trench depth will be constant for each treatment). "Normal" is defined as the normal area exploited per tree in the standard plantation 6m x 3m planting arrangement.

2. Weeding treatment
Two levels of weeding ("high" and "low") corresponding to the same levels in Experiments 1 and 2.

Layout
Replicates: 2 replicates in 1 farmers field in Rantau Pandan village.
Size of replications is 324m2
Topography: flat land
Plots: each replicate is divided in 6 plots. Plot size is 3 trees per plot.
A weeding treatment is assigned randomly to each replicate.
Thus in total: 2 blocks, 5 treatments, 12 plots (see figure 5).





S	Small	3m x 9m	HW	High weeding
N	Normal	6m x 9m	LW	Low weeding
L	Large	9m x 9m		

o Rubber tree

ANNEX 11

Study of the effect of slash and burn techniques on soil fertility

Slash-and-Burn as Land Clearing Method in Sepunggur, Jambi Province, Sumatera, Indonesia

Results of a Social/Economic/Agronomic Survey

by

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Abstract

The search for alternatives to slash-and-burn agriculture and slash-and-burn as a land clearing method requires an in-depth knowledge on and diagnosis of the problems that rise with the present management system. A social/economic/agronomic survey on slash-and-burn as a land clearing method (S&B-Survey) was conducted among 30 rubber smallholders in the Sepunggur area, Jambi Province, Sumatra, Indonesia. Objectives of this survey are: 1) to characterize slash-and-burn techniques; 2) to characterize farmers' perspectives on the land clearing methods related to agronomic aspects (soil fertility, plant growth, production), and 3) to evaluate the importance of and alternatives for slash-and-burn as a land clearing system to smallholders and at community level at present and in the near future. In this paper we present the results of this survey.

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Slash-and-Burn:

What are the direct effects of the burn on soil fertility (chemical/physical/biological properties) and what does slash-and-burn as land clearing method for establishing new rubber gardens mean to the smallholder rubber farmer.

Research conducted in Sepunggur, Jambi Province, Sumatra, Indonesia.

Research Team:

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ABSTRACT:

Rubber agroforests cover over 2 million of hectares in Indonesia where rubber is one of the main export commodities and smallholders are the main producers. Due to a rapid growing population pressure, the traditional slash-and-burn agriculture with shifting cultivation of food crops is no longer sustainable and environmentally acceptable. Alternatives will need to be developed.

This research is part of the Alternatives to Slash-and-Burn and the Smallholder Rubber Agroforestry Projects and aims at characterizing the effects of burning events (temperature and ash addition) on soil fertility (chemical, biological and physical properties). All research is conducted in the Sepunggur area, Jambi Province, Sumatra, Indonesia.

Our hypotheses are: 1) the short term effects of slash-and-burn methods on increasing nutrient supply in the topsoil is directly related to the temperature exposure during the burn and increased temperature of the topsoil after the burn and thus to the fuel load before the burn; changes in soil organic matter pools are as important for the subsequent nutrient supply as the direct contributions by ash; and 2) a reduction in the fuel load in the field before a burn will reduce soil temperatures during the burn, thus reducing the mobilization of nutrients (especially phosphorus) from resilient organic pools.

This research on chemical, physical and biological properties is accompanied by a social economics survey conducted in the Sepunggur area.. With this survey of approximately 40 farmers we aim to characterize present slash-and-burn practices, farmers' perspectives on slash-and-burn, and the importance and future of burning for Sepunggur farmers.

Introduction

Soil phosphorus is next to soil nitrogen the most limiting nutrient in the agroforestry systems in Sumatra. Both nutrients are inseparably connected to soil organic matter. Soil organic matter is linked to desirable physical, chemical and biological properties and is closely associated with soil productivity, especially in the humid acid soils (ultisols or oxisols) of Sumatra. Soil organic matter characteristics are potentially the single best integrator of inherent soil productivity, tilth, environmental buffering, and soil resilience.

Shifting cultivation farmers originally could select fields based on properties that they desired and connected with highest yields possible for cultivation of crops, next to infrastructure related issues (proximity to a market etc.). Now the total area of forest that can still be opened is diminishing, farmers are forced to open increasingly younger secondary forest and to cultivate fields for longer time periods. Younger forest will differ in diversity, composition, and in total biomass to be slashed and burnt. This is likely to reduce temperatures during the burning event. What does it mean for the fertility status of the soil at the moment of planting and how does that relate to performance of the next rubber crop?

Hypotheses

Our hypotheses are: 1) the short term effects of slash-and-burn methods on increasing nutrient supply in the topsoil is directly related to the temperature exposure during the burn and increased temperature of the topsoil after the burn and thus to the fuel load before the burn: changes in soil organic matter pools are as important for the subsequent nutrient supply as the direct contributions by ash; and 2) a reduction in the fuel load in the field before a burn will reduce soil temperatures during the burn, thus reducing the mobilization of nutrients (especially phosphorus) from resilient organic pools.

Objectives

In order to test our hypotheses we will:

1) characterize forest vegetation, both tree species diversity and total biomass (fuel load);
1) monitor temperatures during a burning event and relate those to the amount of fuel load on the field prior to burning;
2) study the relationships between fuel load, temperatures during a burning event and changes in soil properties: pH, EC, exchangeable cations, exchangeable acidity, ECEC, P-Olsen, N-total, C total, C-organic, Ludox organic matter fractionation, P-fractions, aggregate distribution, aggregate stability, color, bulkdensity, soil respiration, total microbial population, total fungi, *Azotobacter spp.*, and soil mineralogy;
3) monitor changes in soil properties in the field over time;
4) link changes in soil properties to crop growth (young rubber in the field and test crop for a greenhouse experiment);

results of findings related with objectives 1 through 4) in a soil organic matter and phosphorus submodel to the Wanulcas model in Stella^{II}, a multi-level hierarchical environment for constructing and interacting with models.

Research is conducted in fields and in labòratorium settings, on microscale (1*1 m) and on plot scale (30*40 m). A survey on slash-and-burn practices is being done to place the importance of our findings in a social-economics context.

Materials and Methods

This research has ten main components:

1) laboratory experiments to examine the effect of temperature (level and duration) and ash addition on relevant soil organic matter fractions, soil phosphorus availability, soil microbial activity and general soil fertility parameters (project one)
2) description of microvariability in total fuel load, soil properties, and weed growth within a field after burning and analysis of the data using geostatistical models (project two);
3) detailed sampling of second burn burning spots to estimate the combined effects of temperature and ash/nutrient addition at three different levels of temperature exposure gradients on small distances (project three);
4) a field trial in which the effects of biomass fuel prior to burning (three levels: reduced, ambient and increased) on soil chemical properties are studied. Each treatment included a factor with or without ash/nutrient addition by means of zinc plates implemented on top of the soil to prevent nutrient flushes after burning (project four);
5) field experiments in which five selected sites are closely evaluated for temperature during a burning event and sampled for chemical/physical soil fertility parameters directly before and after burning (project five);
6) effect of burning on earthworm populations (project six);
7) farmers survey on slash-and-burn practices (project seven);
8) XRD analyses of soil exposed to different temperatures during a field burn in order to study effects of the burn on soil mineralogy (project eight);
9) greenhouse experiment with a test crop to relate nutrient availability after a burn to nutrient uptake by the test crop (project nine);
10) development of a burning event and phosphorus-soil organic matter interaction model and incorporation for this model into the presently developing soil organic matter model (Stella II model, small time intervals) (project ten).

Short project descriptions of each of the ten projects will follow.

Short project descriptions (material and methods only)

Project one: laboratory experiments to examine the effect of temperature (level and duration) and ash addition on relevant soil organic matter fractions, soil phosphorus availability, soil microbial activity and general soil fertility parameters.

Experimental Design:

Topsoil (0-5 cm) of the same field as in phase one was collected (67 different locations). All samples were mixed (composite sample) and units of 400 gram fresh-weight were made (126 experimental units, six inoculate bags). All units were brought to field capacity and let to stand for two weeks. After two weeks of equilibration six bags were kept on field capacity to serve as inoculate whereas all other units were left to dry at 40°C for three days prior to treatment in the oven. This was done to simulate drying of a field prior to burning and to bring the samples to a moisture content conform with those measured in the field directly prior to burning.

Treatments were determined in such a way as to cover three different levels of temperature exposure (100, 300 and 600 °C), three different durations of exposure (5 minutes, 205 minutes and 1449 minutes). The durations for the 205 minutes and 1449 minutes treatments were chosen to obtain three intensity levels. Temperature sums were calculated based on temperature measurements (every ten minutes) in the oven when cooling down from either 600 or 300°C to 100°C. The curves (temperature versus time) thus obtained were fitted through an exponential decay function:

$$T = a * e^{(-b * t)}$$

in which

T = temperature in °C
t = time in minutes since turning off the oven

Integration to obtain temperature sums resulted in three equations:

$$t2 = \frac{5 * (600-T_{room}) + (500/b1) - 200/b3)}{(300-T_{room})}$$

$$t3 = 5 * \frac{(300-T_{room})}{(100-T_{room})} + \frac{1}{b2} * \frac{(200)}{(100- T_{room})}$$

$$t4 = 5 * \frac{(600-T_{room})}{(100-T_{room})} + \frac{1}{b1} * \frac{(500)}{(100- T_{room})}$$

where

T_{room}	= 28°C
b1	= fitted parameter in equation (1) for an oven cooling down to 100°C after 5 minutes at 600°C.
b2	= fitted parameter in equation (1) for an oven cooling down to 100°C after 5 minutes at 300°C
b3	= fitted parameter in equation (1) for an oven cooling down to 100°C after 205 minutes at 300°C
t2	= minutes at 300°C to obtain the same temperature sum obtained with 5 minutes at 600°C and t4 minutes at 100°C

and t4 minutes at 100°C

t3 = minutes at 100°C to obtain the same temperature sum obtained with 5 minutes 300°C

t4 = minutes at 100°C to obtain the same temperature sum obtained with 5 minutes at 600°C and t2 minutes at 300°C

Curvefitting the temperature data through an exponential decay function with a constant a equal to 600 (b1) or 300 (b2 and b3) resulted in the following values for b1, b2 and b3:

b1 = 0.062887 (n=6)
b2 = 0.014925 (n=6)
b3 = 0.011275 (n=6)

The experimental design hence became:

temperature: (°C)	duration: *(min)*	intensity: (°Cmin)
600°C	5	83532
300°C	5	15605
300°C	205	83532
100°C	5	360
100°C	205	15605
100°C	1149	83532
control	-	-

All treatments were done in triplicate. After treatment in the oven at the set temperature and letting the samples cool down till 100°c inside the oven, samples were kept in one liter heat resistant plastic bags which were closed with a cotton ball to allow air flow but prevent microbial contamination. Moisture content and field capacity were determined immediately after treatment (n=3). All bags were then brought to 75% field capacity and inoculated with 1% of the original soil (inoculate bags) depending on the actual sampling time according to the following schedule:

Sampling time (days after treatment)	inoculation
1	no
7	yes
14	yes
28	yes
28	no

On the specific sampling days, 10 gram subsamples were taken and microbial populations were determined. The remaining soil was dried and sieved for further chemical analyses. Day one samples were used for aggregate distribution and stability analyses directly after treatment. Day one samples were also used for incubation for soil respiration measurements.

Microbial Populations:

On every sampling date the total populations of microbes, fungi, and *Azotobacter* were determined using a colony count method. Selective media for the different populations were:

- nutrient agar for total microbes (counting after two days incubation at room temperature)
- Martin media for total fungi (counting after two days incubation at room temperature)
- Ashby medium for azotobacter (counting after two days incubation at room temperature)

Dilution series were made and colonies were counted after incubation at room temperature for two or three days (see scheme above). Counts were considered valid when the number of colonies was between 30 and 300 per plate.

Soil Respiration

Soil respiration was determined using 5 ml of 0.2 M KOH as CO_2 trap. Directly after treatment 100 gram of 75% field capacity soil was incubated in five liter plastic containers. Each sample was incubated with and without inoculation with 1% of the original soil. Thus per treatment six samples were incubated (three replicates each with and without inoculation). A film container with water was added to keep the moisture content inside the incubation jars constant. CO_2 contents were measured after 3 days, and then on a weekly bases from one week after treatment till 10 weeks after treatment.

The amount of CO_2 evolved was determined by titration with a standardized 0.1 M HCl solution. Per set of samples (treatment) two blanks were included. The total amount of C-CO_2 evolved was calculated as:

$$\text{C-CO}_2\ (\text{mg/kg.day}) = \frac{(\text{ml HCl}_{\text{blank}} - \text{ml HCl}_{\text{sample}}) * n * 120}{\text{days incubation}}$$

where n = normality of the HCl solution.

Soil Chemical and Physical Parameters

All samples were analyzed for the following set of chemical and physical soil parameters: color, aggregate distribution, aggregate stability, ash content, field capacity, exchangeable cations, acidity, EC, pH, phosphorus fractions, soil organic matter fractions at two different time intervals: one day after heat exposure, four weeks with inoculation and four weeks without inoculation.

All day-1 samples were dry-sieved (after drying) during one minute on a stacked set of sieves: 2 mm, 250µm, and 150µm. Thus four fraction were obtained: >2 mm, 250 µm-2 mm, 150-250 µm, and <150µm. Aggregates of the two largest size fractions were selected for stability measurements. Aggregates were sieved under water for 3 minutes at rpm and an amplitude of 5 cm without any pretreatment. All samples were sieved in triplicate. Water-stability is expressed as:

$$\text{water-stability (\%)} = \frac{\text{aggregates left on the sieve after sieving (gram)}}{\text{initial weight of aggregates (gram)}} * 100$$

Project two: description of microvariability in total fuel load, soil properties, and weed growth within a field after burning and analysis of the data using geostatistical models.

Field selection:

The field selected for this experiment is a 12-15 year old secondary forest in the Sepunggur area in Jambi Province in Sumatra, Indonesia. The farmer, Mr. Zulkifli, slashed this approximately 70*50 m area in August 1997, left the field to dry during the following months and burned the field on December 24th, 1997. Prior to burning the field, a 30*40 m plot was established within the slashed area.

Tree genera diversity:

Tree genera diversity prior to slash-and-burn was estimated in a 30*40 m plot of still remaining secondary forest just outside of the slashed area. Due to the fact that the actual plot had already been slashed prior to arrival at the field, the actual plot could not be sampled for tree genera and a representative plot in the immediate surroundings was sampled. All trees of diameter larger than 3 cm were counted, breast-height-diameter and height were measured and the genera determined.

Tree biomass prior to and after slash-and-burn:

In a grid of one by one meter height of total surface material was estimated and calibrated with total biomass per surface area (spatial variability data). In addition, measurements of breast-height-diameter (D in cm) of all trees and height (H in m) of the trees where possible, were taken after burning (for field scale comparisons). Using site specific equations developed in project five total tree biomass prior to burning and after burning will be estimated. Conversions of tree breast-height-diameter and height to total biomass will be done based on equations developed in phase four, which will be compared to the above equations (1) and (2).

The amount of wood left in the field after burning was calculated with the following equation:

$$\text{tree biomass (kg/tree)} = D^2 / 4 * \pi * h * s \qquad (1)$$

where s is the specific gravity estimated to be 0.54 g/cm^3 (n=30). The specific gravity was determined for all trees that contributed to the development of the equation (see project five).

Surface material:

In a grid including 67 points within the 30*40 m plot total surface material was collected from 15*15 cm areas prior to burning. This surface material was separated in four size fractions: larger than 2 mm, 2 mm- 250 µm, 250 -150 µm, and smaller than 150 µm. The two largest fractions were separated in surface organic and surface mineral material using water. The organic fractions are used for determination of the total amount of organic material on the field prior to burning.

The same method of sampling and fractionation was used for determination of total surface material after burning. However, for sampling two days after burning only those locations out of the 67 that fell within the burned area (a total of 31 samples) were sampled.

During the sampling two months after burning (tree planting time) a new sampling scheme was chosen in which a regular grid of 48 points was taken (six locations in the row, eight in a column) and an additional 12 locations were selected randomly chosen between grid points (at half grid distance either between points in a row (six locations) or between point in a column (six locations)).

Soil sampling:

Samples were taken at the same locations as where surface material was collected over a depth of 0-5 cm (top soil) and 5-15 cm (subsoil). All samples were sieved through a 2 mm sieve and dried (air-dry) prior to analyses.

Soil analyses:

pH (water), pH (0.01M $CaCl_2$) and EC were measured using a soil/water ratio of 1/5. Soil organic matter fractions were obtained using the LUDOX fractionation method. Exchangeable cations will be determined in a $BaCl_2$ extract. Exchangeable acidity and soil phosphorus fractions (and P-resin extractions) will be done. Total ash content was determined by dry combustion at 550°C.

Weed growth:

Total weed biomass was determined in a grid of 100 sampling points of each 25*25 cm. Out of the 100 locations, 80 were placed in a regular grid of eight by ten locations. The remaining 20 samples were randomly chosen at half distance between grid points wither within columns or within rows. All weeds per area were collected, dried and weighted.

Bulk density:

At the same locations as were weeds were sampled, soil bulk density samples were taken. Ring samples of 177 cm^3 were taken, dried and converted to bulk density in two different layers (0-5 and 5-15 cm).

Aggregate size class distribution:

All bulkdensity samples were sieved after drying to obtain aggregates of four different size classes: >2 mm, 2 mm-250 µm, 250 -150 µm, and smaller than 150 µm. Subsamples will be send to Wageningen Agricultural University to determine aggregate water-stability (see method description in project one).

Statistical analyses:

All maps will be generated using the (co-)krigging options in Genstat. Since different sampling schemes were used, overlayes will be made, estimating values for missing parameters for a regular grid of 100 points and compare these values before and after burning to determine trends/relationships between fuel loads and soil and above ground properties.

Project three: detailed sampling of second burn burning spots to estimate the combined effects of temperature and ash nutrient addition at three different levels of temperature exposure gradients on small distances.

This project consists of two phases: A) a sampling for chemical/physical properties four months after burning; and B) sampling newly burned burning spot over time for chemical and microbial properties.

Project A:

Field selection:

The field selected for this experiment is a 15 year old secondary forest in the Sepungur area in Jambi Province in Sumatra, Indonesia. Mr. Taridi, the farmer, burned this field in August 1996. The entire field is about two hectares large. Rubber had already been planted (at fixed planting distances) when the field was sampled for the first time (December 1996) but dark round burning spots remained visible on places where the soil had remained untouched (except for weeding). Six one to one and a half meter diameter burning spots (6 replicates) were selected outside the cultivated areas. Six additional sites were marked for future sampling (one year after burning).

Sampling surface material and soil:

A transect of ten 15*15 cm squares was drawn over each burning spot with the center of the transect in the center of the burning spot. Two samples (also 15*15 cm) were taken along the same line but one meter removed from the last samples in the transect, thus functioning as control (see figure). From each 15*15 cm square surface material was obtained (quantitatively). This surface material was separated in four size fractions: larger than 2 mm, 2 mm- 250 μm, 250 -150 μm, and smaller than 150 μm. The two largest fractions were separated in surface organic and surface mineral material using water. The organic fractions are used for determination of the total amount of organic material on the field prior to burning. Soil samples were taken at the same locations as where surface material was collected over a depth of 0-5 cm (top soil) and 5-15 cm (subsoil). All samples were sieved through a 2 mm sieve and dried (air-dry) prior to analyses.

Soil analyses:

pH (water), pH (0.01M $CaCl_2$) and EC were measured using a soil/water ratio of 1/5. Soil organic matter fractions were obtained using the LUDOX fractionation method. Exchangeable cations will be determined in a $BaCl_2$ extract. Exchangeable acidity and soil phosphorus fractions will be determined. Total ash content was determined by dry combustion at 550°C.

Statistical analyses:

For each of the six locations within the field, regression analyses between distance from the center and the respective soil properties and surface material will be done. The different regression curves will be compared using mean comparisons (t-test).

Project B:

Field selection:

The field selected for this experiment is a 12-15 year old secondary forest in the Sepunggur area in Jambi Province in Sumatra, Indonesia (same location as for prject two). Mr. Zulkifli the farmer, burned this field for the first time in July 1997. The entire field is about 0.75 hectare large. Three second burn piles were established (400 kg of wood with diameters between 2.5 and 10 cm) on an area of 3*3 m. Piles were burned, burning temperatures measured (using crayons) and locations selected based on their temperature exposure: 600, 300 and 100°C. For comparison at each sampling time control sample was take in the forest nearing the burned field.

Field sampling:

Each location was sampled before the burn, one day after the burn, one week, two weeks, four weeks and two months after the burn for soil chemical and microbiological properties. Soil respiration was measured each week after thweburn for a period of two months.

Soil analyses:

pH (water), pH (0.01M $CaCl_2$) and EC were measured using a soil/water ratio of 1/5. Soil organic matter fractions were obtained using the LUDOX fractionation method. Exchangeable cations will be determined in a $BaCl_2$ extract. Exchangeable acidity and soil phosphorus fractions will be determined. Total ash content was determined by dry combustion at 550°C. Bulk density, color and aggregate distribution and stability will be measured at each sampling time.

Soil microbiological measurements:

Samples were analyzed for total microbes (total number of propagules), total fungi and *Azotobacter* spp. Field respiration was measured using 2-hour KOH incubations. At the first sampling date (one day after the burn), soil was taken from the different treatments and incubated for respiration measurements (100 gram field capacity soil incubated with KOH) in the laboratorium as well.

Project four: a field trial in which the effects of biomass fuel prior to burning (three levels: reduced, ambient and increased) on soil chemical properties are studied. Each treatment included a factor with or without ash/nutrient addition by means of zinc plates implemented on top of the soil to prevent nutrient flushes after burning.

Experimental design and field selection:

This experiment was conducted as a split plot design in three replicates. The field selected for this experiment is a 12-15 year old secondary forest in the Sepungur area, Jambi Province in Sumatra, Indonesia. Nine main plots (5*5 m) were established. All surface material was removed from the plots prior to implementation of the experimental units. Within each main plot six 80*80 cm subplots were located. Three out of the six subplots (randomly chosen) were covered with a 80*80 cm zinc plates (with standing edges of 5 cm). The zinc plates allow separation of temperature and ash addition effects on soil properties. After implementation of the plates all main plots were covered by a litter layer of 38 kg fresh weight (1.5 kg/m^2). This amount was determined to be the average surface litter coverage rate of the entire experimental area (30*40 m). For three out of the nine main plots, the surface litter layer formed the only fuel load. In three main plots, 50 kg of branches (2 kg/m^2) with a diameter smaller than 1.6 cm were added on top of the surface litter layer. The remaining three plots received, in addition to the surface litter, 100 kg (4 kg/m^2) of less than 1.6 cm diameter branches, 100 kg (4 kg/m^2) of branches with diameters between 1.6 and 6.4 cm, and 100 kg (4 kg/m^2) of tree trunks and bigger branches (>6.4 cm diameter). The latter was added in 6-20 kg pieces which allowed recovery of the individual pieces in incomplete in order to estimate the percentage burned material. Temperature crayons were inserted to monitor temperatures during the burn and to check the effect of inserting the zinc plates on temperature regime. All plots were left to dry for a period on six weeks and then set on fire. During the fire, the duration of fire exposure was measured for each plot.

Temperature registration:

Temperature crayons were inserted at five different depths: surface, 2.5 cm, 5 cm, 10 cm and 15 cm depth. After the burn the crayons were removed and temperatures registered.

Surface material sampling:

Directly after burning the weight of the individual large wood (>6.4cm diameter) logs in the increased fuel load plots was determined in order to calculate the percentage weight loss due to the burn. In all plots the total amount of surface material left on top of the zinc plates after the burn was determined (and removed). Surface material was separated in four classes: >2mm, 2mm-250μm, 250-150μm, and <150 μm.

Soil sampling:

All subplots were sampled over two layers (0-5 cm and 5-15 cm). In the subplots where no zinc plates were installed sampling was done by carefully removing the surface material, taking the soil sample and replacing the removed surface material to its original position.. All subplots were sampled before burning, directly after burning, and after five weeks (directly prior to planting the new young rubber trees). Soil samples were analyzed for pH (water), pH ($CaCl_2$), EC, exchangeable bases, exchangeable acidity, ash content, C-organic, N-total, P-Bray, P fractions, soil organic matter fractions. Surface material was analyzed for total carbon, nitrogen and phosphorus pools. The color of each of the plots was determined and bulk density and aggregate distribution samples were taken.

Project five: field experiments in which five selected sites are closely evaluated for temperature during a burning event and sampled for chemical-physical soil fertility parameters directly before and after burning.

Field selection:

Five location (six fields) have been selected in the Sepunggur area. Plots of 30*40 m have been located in each of the locations. Fields were selected based on the age of the vegetation (all secondary forest/jungle rubber).

Biomass determination:

In each plot the total biomass undergrowth was determined (15 one meter square plots covering the entire range from no surface material to the maximal amount of surface material as a calibration for the conversion of average height measurements for each square meter over the entire plot to total biomass), all trees measured for breast-height-diameter and total height and converted to biomass based on calibration with a total of 30 trees that were actually measured by weighing the trees in different fractions.

Soil sampling:

Each plot was sampled for soil properties prior to burning using 10 composite samples (each a composite of five). Soil was sampled over three layers: surface material, 0-5 cm, and 5-15 cm). All plots were sampled prior to burning, one day after burning and five weeks after burning. Samples were analyzed for pH, EC, exchangeable cations, exchangeable acidity, ECEC, organic C, ash content, total N, P-Bray, Ludox fractionations, P factions, color, aggregate distribution, aggregate stability and bulk density.

Temperature registration:

A total of 25 temperature crayons were used to measure surface temperatures during the burning event.

Rubber growth monitoring:

All plots will be monitored for rubber growth (diameter and height).

Project six: Effect of burning on earthworm populations

Field selection and sampling:

A newly burned field was sampled for earthworm populations in the center of the field, on the border with the forest and in the adjacent forest. Each locations was sampled in six replicates using handsorting for the soil layers 0-5 and 5-15 cm deep and a formaline solution to extract earthworms from deeper layers. All three locations were sampled two weeks after burning (first burn) and will be sampled again at one month, and two months after burning.

Project seven: farmers survey on slash-and-burn practices.

This research project will result in approximately 40 surveys of farmers (smallholders) in the Sepunggur area and 10 surveys in the transmigration area (mainly Javanese that transmigrated to Sumatra in some form of a government program). These surveys will indicate farmer's motivation for burning (as opposed to mulching) and removing wood prior to burning, frequency of opening new fields, average field sizes of newly opened plots, burning practices, and farmers opinions on the future when the total forest surface will continue to diminish and landscapes are very likely to look like seemingly unending rubber and oilpalm plantations.

Project eight: XRD analyses of soil exposed to different temperatures during a field burn in order to study effects of the burn on soil mineralogy.

Forest soil and soil exposed to 600, 300, and 100°C was taken over two depths: 0-5 cm, and 5-15 cm. The field selected for this sampling is one of the five plots of project five. All samples were dried and sieved and will be transported to Ohio State University for XRD analyses.

Project nine: greenhouse experiment with a test crop to relate nutrient availability after a burn to nutrient uptake by the test crop.

This experiment will be conducted at Ohio State University in 1998.

Project ten: development of a burning event and phosphorus-soil organic matter interaction model and incorporation for this model into the presently developing soil organic matter model (Stella II model, small time intervals).

To be conducted when results of projects 1 till 9 are known and analyzed.

Involved institutions/collaboration

This project will be financed by several different institutions: Ohio State University Graduate School supplied a fellowship the first year tuition, fee waiver and stipend as part of the Multiple-Year European Agricultural Fellowship/Associateship by the Ohio State University Graduate School and the Environmental Science Graduate Program. The travel expenses between Columbus, USA and Jakarta, Indonesia are covered by a Scholarship from the Mervin G. Smith International Studies Fund and by an Ohio State University Graduate School Alumni Research Award. A research and travel budget is supplied by the Smallholder Rubber Agroforestry Project (a collaboration between GAPKINDO, CIRAD-CP, Sembawa Rubber Research Institute, and ICRAF) supplemented by funds from the Alternatives-to-Slash-and-Burn project supported by the Global Environment Facility with UNDP sponsorship.

ICRAF 1997

Can agroforests be managed without the use of slash-and-burn methods?

Smallholders in Sumatera use slash-and-burn methods to rejuvenate their jungle rubber agroforest, as well as to expand their farms into logged-over forest, as we found in the characterization phase of the 'Alternatives to Slash and Burn' project. Alternatives should address the various functions which fire has in the way it is currently used (Fig. SEA 1).

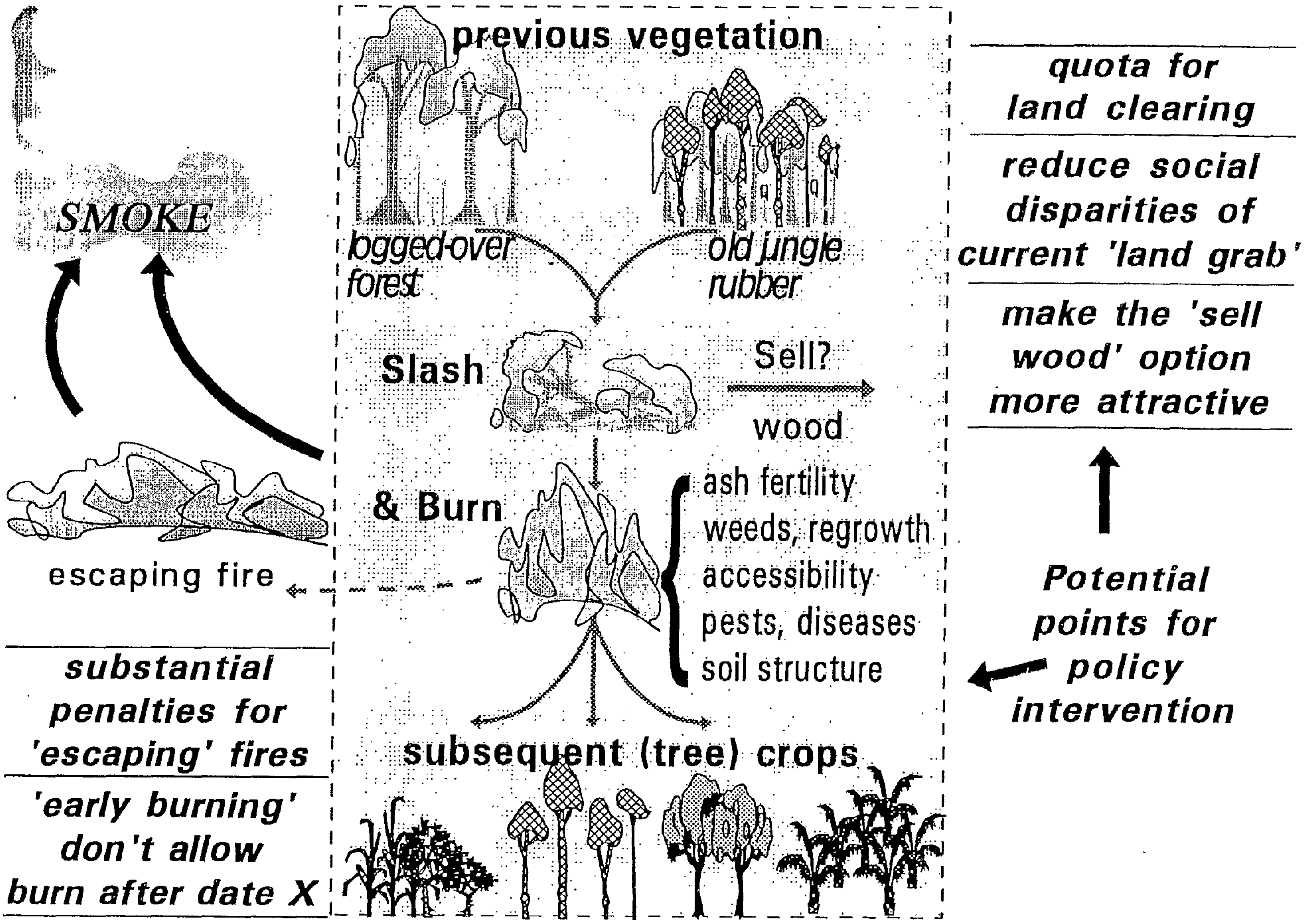


Fig. SEA 1. Steps in the slash-and-burn process and its links with problems of escaping fires and smoke, with various entry points for policy intervention

In a survey in Jambi (Sumatra) of the reasons farmers have to use slash-and-burn methods (Fig. SEA 2), the primary concern (51%) was with accessibility of the plot, allowing the farmer to move around. Chemical and physical soil fertility were mentioned by 41% of the farmers and pests, diseases and weeds by only 8%. Alternative techniques would thus have first of all have to clear away the trees - which is nearly impossible without mechanization - and then address the soil fertility concerns of farmers.

(G. Ketterings 1997)

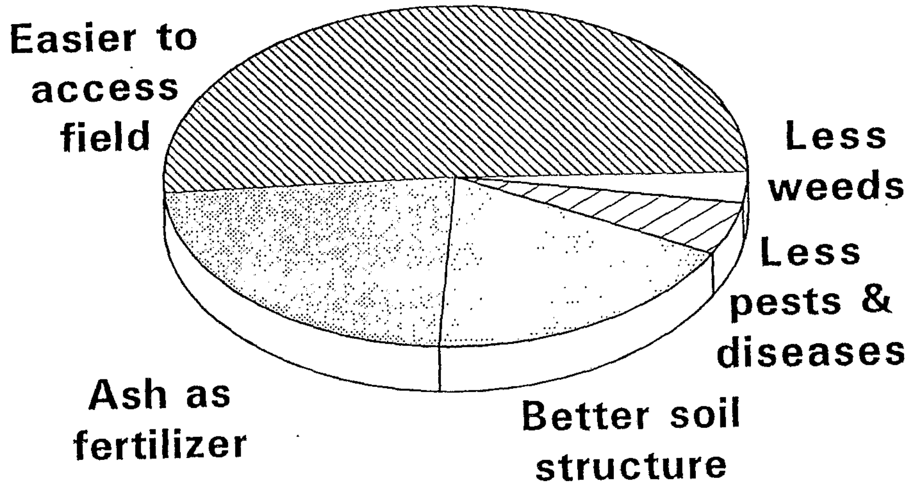


Fig. SEA 2. Main reason given by farmers in Jambi (Sumatra) for using fire in land clearing for rejuvenation rubber agroforest

We asked farmers for each crop they are planting whether they would expect problems if they would have to use slash-and-mulch techniques in stead of slash-and-burn. According to all farmers the yield of chilly pepper and other vegetables would decrease if no fire could be used for land clearing, but for the tree crops opinions varied; for rubber 80% of farmers expect a yield delay but only 60% a yield reduction if a slash-and-mulch technique would replace a slash-and-burn method (Fig. SEA 3).

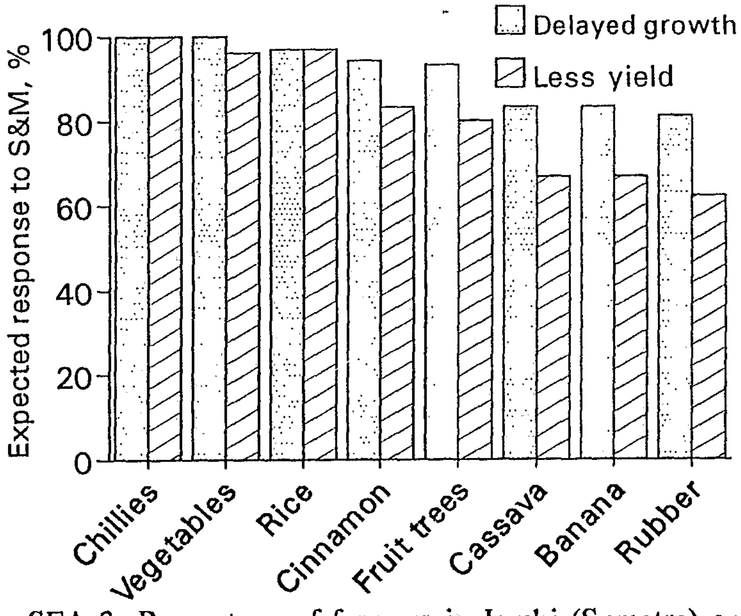


Fig. SEA 3. Percentage of farmers in Jambi (Sumatra) expecting a delay or reduction in yield if slash-and-mulch methods would replace slash-and-burn

The conventional explanation for the increased nutrient availability after slash-and-burn is based on the nutrient content of the slash, turned into ash by the fire. Depending on the intensity of the fire, however, considerable amounts of soil organic matter in the surface litter layer and upper centimeters of the soil are affected as well, and this may lead to a mineralization of P from resistant organic P forms. A series of detailed experiments was initiated to separate the '(sl)ash' from the 'burn' effect. Surface temperatures in farmer's fields during the burn varied from less than 200 to over 600°C. In this temperature range strong effects on soil organic matter were recorded in oven experiments where peak temperature and duration of heat were varied. Within-field variability of amount of biomass is related to the variation in peak soil temperature during the burn, and thus to subsequent soil fertility. Farmers plant nutrient-demanding crops such as chilly peppers specifically in ash sites.

As part of this research of direct effects of slash-and-burn, we calibrated a number of 'allometric' equations, for predicting total tree biomass from tree diameter at standardized height (D). Best result were obtained with an equation of the form $Y = a D^b$, where Y is biomass (kg/tree), a a proportionally factor and b a 'fractal' dimension. A new data set from Jambi fitted well with data from elsewhere in the humid tropics, and we now recommended a value of 0.092 for a and 2.60 for b for future studies. The value of x is consistent with a proportionally of total tree biomass to stem volume ($\pi D^2 H/4$ where H is tree height), as H was found to be proportional to $D^{0.6}$. The same allometric equation is used for assessing carbon stocks in aboveground biomass in the context of C sequestration.

Two methods exist for rejuvenating rubber agroforest - one based on clear felling by slash-and-burn method and field-level replanting (with or without associated food crops in the first few years), the second on gap replanting in existing agroforests. Most of the attention in the 'smallholder rubber agroforestry project which tests the use of 'domesticated' rubber clones under smallholder management conditions (see pp 157-159 in ICRAF annual report 1994 and pp ... in this report) has been given to the first approach. Competition for light and nutrients between young rubber and regrowing forest vegetation (which can be reviewed as 'weeds' and as 'biodiversity') will determine the success of rubber establishment in both settings, if the rubber escapes from attacks by wild pig and monkeys. We tested the hypothesis that increased nutrient supply to the rubber trees by fertilizer addition in the planting hole, would reduce the sensitivity of young rubber to weed competition. Results for the first two years (Fig. SEA 4) show a significant response to small dose of N and P fertilizer at planting time (N_1P_1), but not to subsequent fertilizer use. The standard recommendations of fertilizer use for 'plantation ' style rubber management (equivalent to the highest rate tested in the experiment) do not yet have a measurable effect on the rubber in this plot derived by slash-and-burn from an old jungle rubber vegetation. We may expect, however, that if rubber were to be planted without slash-and-burn, a stronger fertilizer response will be obtained.

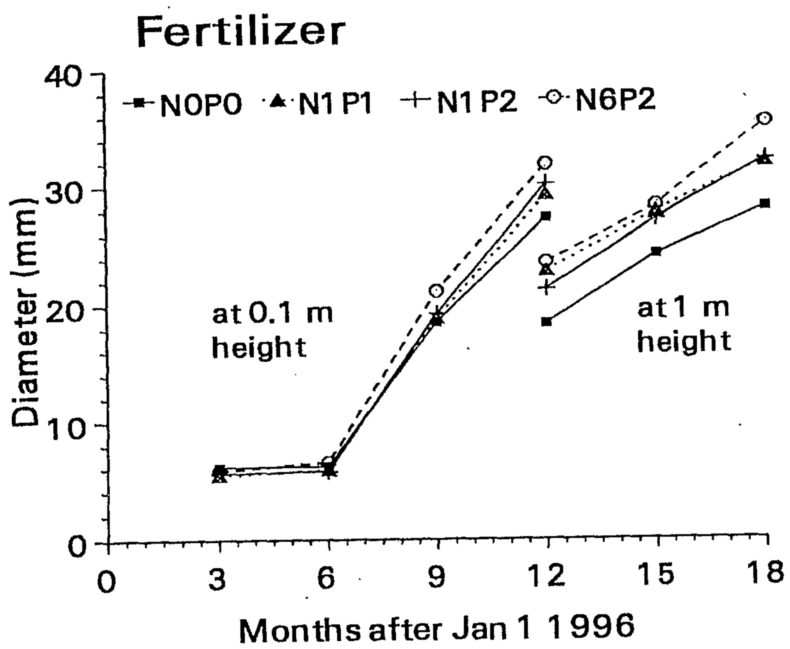


Fig. SEA 4. Stem diameter of rubber with different fertilizer additions in a plot derived by slash-and-burn from an old jungle rubber vegetation.

Competition between young rubber and 'weeds' is based on light as well as soil resources. The root distribution of rubber trees over top and subsoil is affected by the intercrop. Measurements of proximal root diameters of horizontal and vertical roots in an experiment at the Sembawa Rubber Research Station showed that *Imperata* reduced the size of rubber trees but induced a relatively deep root system, without the superficial roots which explore the topsoil in plots without or with less competitive intercrops.

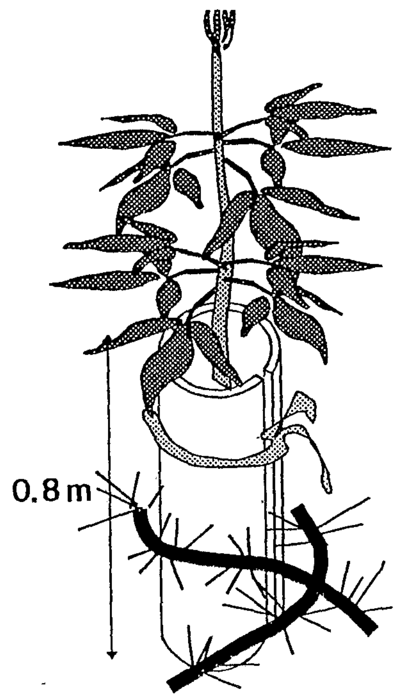


Fig. SEA 5. Farmer-developed techniques for physical protection of young rubber planting material from predation by wild pigs: bamboo shaft and spiny stem of rotan or salak palm; the effectiveness of these methods are currently tested in gap planting of rubber (rejuvenating rubber agroforests without slash-and-burn)

Rejuvenation of agroforests without clear felling is common practice in the damar agroforest of Krui (W. Lampung, Sumatera), but is also an opinion in jungle rubber. A major problem in the use of more expensive rubber planting material instead of local seedlings, however, is the risk of predation by pigs and monkeys. A simple technique developed by farmers in Jambi for protecting young rubber in a bamboo shaft, will be further tested on its effectiveness during gap rejuvenation (Fig. SEA 5).

Development of young trees in gaps in an existing agroforest will further depend on the light regime, as determined by gap size. A model for tree-tree interactions is developed which can predict the full life cycle of trees and will be used to explore farmer management options, including timber harvesting and gap rejuvenation. This model is currently tested by applying it to Damar agroforests in Sumatra. The model is based on individual trees of different species, ages and size and is designed to explore competition for light and space as main tree-tree interaction. Trees are represented as simple 3D distortable objects (an ellipsoid on a stick) reacting to their local environment.

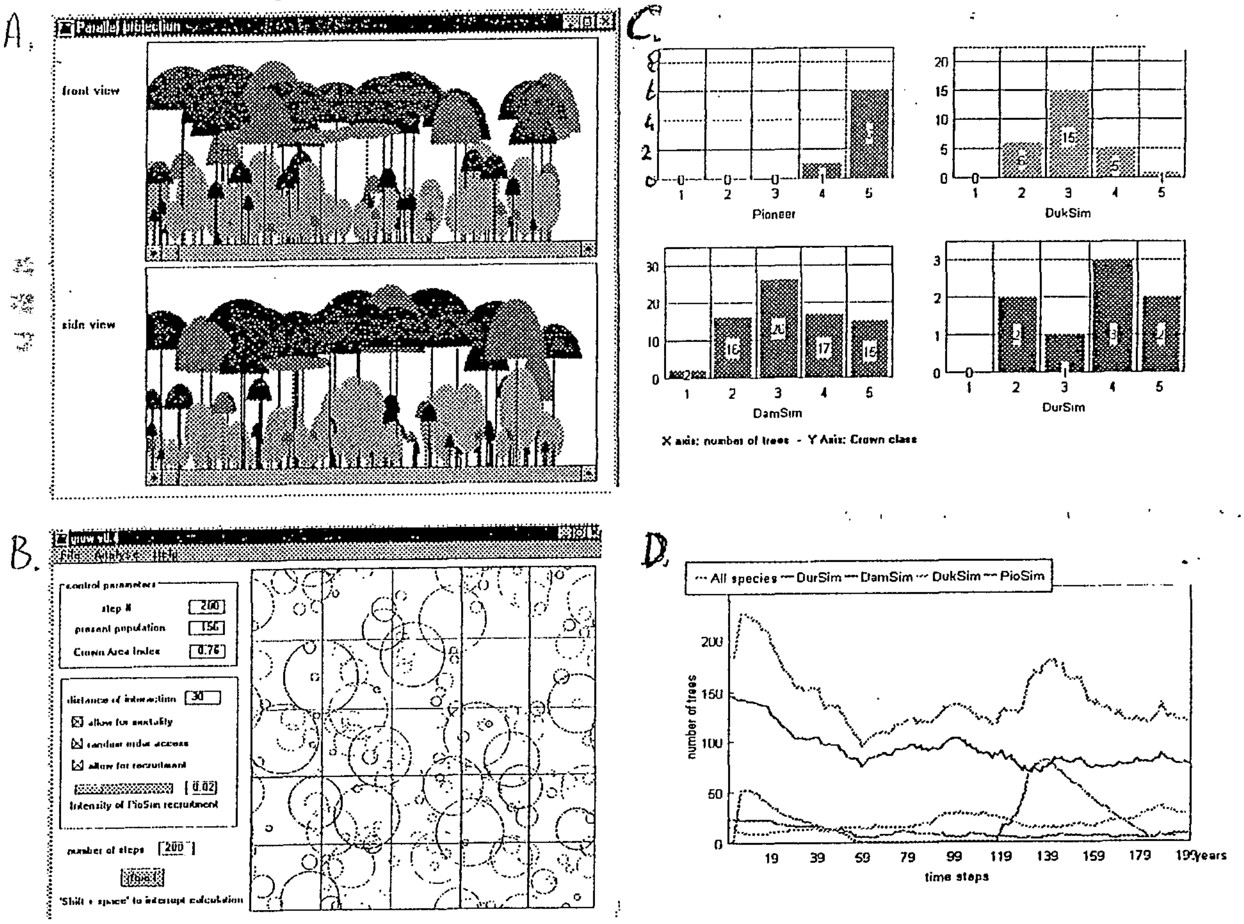


Fig. SEA 6. Output of a dynamic model of tree-tree interactions in agroforests developed at ICRAF: A. Lateral projection of a mixed agroforest stand at a given point in time, B. Top view of the 1 ha plot; different circles indicate four types of trees, C. Number of trees currently in the plot, distinguished by functional group (damsim, duksim and dursim roughly represent damar, duku and durian trees), D. Development of the species composition during 199 years, without specific farmer interventions

The model at this stage simulates a one-hectare plot on a yearly basis, to represent the functioning of a virtual patch of forest consisting of a four 'functional groups' of tree species with contrasting light requirements and growth characteristics ('tree temperament'). Establishment, growth and death of any individual tree are strongly influenced by the amount of light perceived by that tree. Thus at each time step an index of the amount of light available to each tree is computed. In a similar way an index of vigour (based on relative size and asymmetry of the tree crown) is also computed. Both indices are used to determine actual growth increment.

Outputs of the model (Fig. SEA 6) include population characteristics such as the distribution of crown size, the distribution of tree height, death rates, etc. as well as individual characteristics such as growth curves. A real time graphic visualization allows the user to inspect any subgroup of trees at any time by selecting them with the mouse on the screen. At present results are confined to the model itself (sensitivity analysis, general behavior). The light interception sub-model is currently being calibrated against hemispherical photographs. Ongoing research focuses on incorporating indigenous knowledge on "temperament" of the different species (the set of growth-and-development reactions shown by a tree towards its environment during its life cycle) and validation of the model with data from permanent plots.

Text for section on 'sloping lands' or global program 3:
The Wanulcas model (see previous ICRAF annual reports) was used to explore tree-soil-crop interactions on sloping land, where contour hedgerows are used. We can now add two terms to the well known I = F - C equation (I = interaction effect on crops, F = fertility effect, C = competition effect): a term Rs which accounts for the re-distribution of water by run-off and run-on within the alley, and a term Rs which accounts for the redistribution of fertile topsoil during terrace formation (including the 'scouring' effect. For the example given (Fig. SEA 7), the overall yield effect of hedgerows on contours is modest, as it incorporates both positive (F, Rw) and negative (correction for tree area, C, Rs) terms.

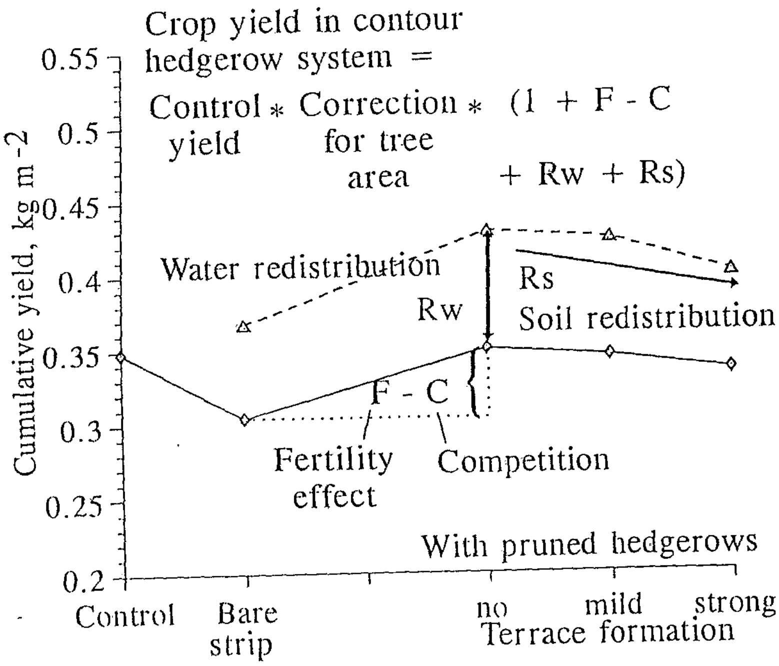


Fig. SEA 7. Model output of the Wanulcas model developed at ICRAF, predicting yield of four subsequent maize crops on sloping land with contour hedgerows which affect the redistribution of water and topsoil, as well as having effects on soil fertility and competing for water and nitrogen with the crop

ANNEX 12

Biodiversity study in rubber agroforests.

BIODIVERSITY IN RUBBER AGROFORESTS

Hendrien Beukema, Fred Stolle and Isron Wah Yudhi

ASB aboveground biodiversity research by ICRAF S.E. Asia in cooperation with the University of Groningen and sponsored by NWO (Netherlands Organization for Scientific Research), UNESCO and ADB.

Abstract of poster for ASB annual review meeting.

Policy issues:

- Land use intensification causes biodiversity loss in Jambi lowlands
- Integration of production values and biodiversity values desirable

The poster displays maps of major land use types in the Jambi lowlands of the early 1980's (based on RePPProT map) and the early 1990's (based on Biotrop map).

We can distinguish two major 'waves' of land use change in the lowlands of Jambi:
1. late 1970's - mid 1990's: logging of primary forests (maps)
2. early 1990's - present: conversion of primary and logged-over forests to large-scale plantations, mainly oilpalm (reconnaissance survey H. Beukema, June/July 1997).
Smallholder rubber has increased gradually over the whole period.

• Land use intensification causes biodiversity loss in Jambi lowlands

Year	Land use type	Biodiversity value	Extent
early 80's	Primary forest	BBB	+ + + + +
	Logged-over forest	BB	+ +
	Smallholder rubber	B	+ +
	Large-scale plantations	-	-
early 90's	Primary forest	BBB	+ +
	Logged-over forest	BB	+ + + +
	Smallholder rubber	B	+ + +
	Large-scale plantations	-	+
2000 ?	Primary forest	BBB	0
	Logged-over forest	BB	-
	Smallholder rubber	B	+ + + +
	Large-scale plantations	-	+ + + + + +

Preliminary results by CIFOR (ASB Indonesia Phase 2 summary report, 1997) show that primary forests and logged-over forests had the highest biodiversity values for vegetation, while values for smallholder rubber are intermediate. We can expect biodiversity values for large-scale plantations to be minimal.

From the observed trend of land use intensification and biodiversity loss we conclude that smallholder rubber agroforest becomes an increasingly important land use type as an option for biodiversity conservation in the Jambi lowlands.
From the present research, we would like to know how much of the forest's biodiversity can be conserved in rubber agroforests on a landscape scale (ß-diversity), under what management (extensively managed 'jungle rubber' to cleanweeded rubber monoculture), and what the trade-offs are between production values and biodiversity conservation values in rubber management.

Research questions:

- Do smallholder rubber agroforests resemble primary forest in structure, and thus provide niches for forest species?
- Do smallholder rubber agroforests show high dissimilarity in fern species composition throughout the Jambi lowlands?
- What is the effect of management on the structure and biodiversity of smallholder rubber agroforests?

Methods:

- Measurements of forest structure in primary forest and rubber agroforests such as Diameter at Breast Height (DBH).
- Collection of terrestrial and epiphytic ferns in 40 x 40 m plots in primary forest, rubber agroforests and rubber plantations.
- Collection of latex production data for the same plots to compare with biodiversity values and management intensity.

Preliminary results:

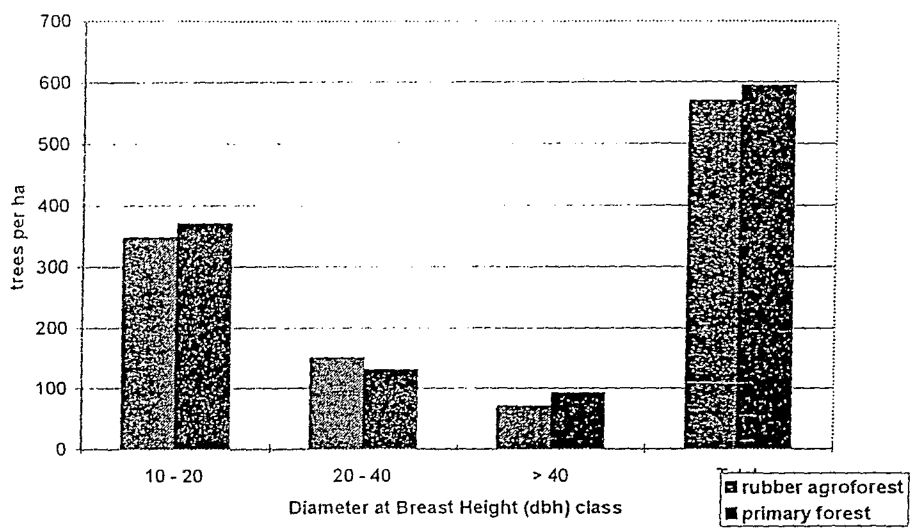
So far the research has focused on the most extensively managed rubber agroforests, the so called 'jungle rubber'.

In Figure 1 the DBH distribution of primary forest (7 plots of 40 x 40m, or 1.12 ha) and jungle rubber (10 plots, or 1.6 ha) is compared. The structure of jungle rubber is forest-like, though not as tall as primary forest. On average only 21% of the trees are rubber trees.

In primary forest an average of 17% of the trees have epiphytic ferns, in extensively managed rubber agroforests this average is still as high as 12% of the trees.

Further research over the next two years will include the more intensively managed smallholder rubber, and will analyse species composition and production data.

Figure 1: The structure of rubber agroforest compared to primary forest



Policy implications:

Support for extensively managed smallholder rubber agroforests as a sustainable land use type, integrating production and biodiversity conservation in the lowlands of Sumatra.

Insight in the trade-off between production values and biodiversity values in the management of smallholder rubber.

ANNEX 13

Study of the effect of light availability and weeding on ground cover vegetation

Florida University

Sadahisa Kato
June 11, 1997

NSC. 6 mo

General area of interest

Smallholder rubber agroforestry in Indonesia: the effect of light availability and weeding on ground cover vegetation / above ground tree-tree interaction

Specific subarea of interest

On-farm experimentation of rubber agroforestry systems (RAS); more specifically, RAS 2 RAS ~~2.2 (r~~ubber + fruit and timber trees + rice intercropping ~~during the fir~~st three to four years)

Unanswered questions to subarea of interest

1. How does light availability at the ground level affect ground cover composition?
2. Does frequent weeding affect the vigor and the composition of weed over a period of time?
3. What is the effect of weeding on soil organic matter (SOM) and nutrient availability to crops?

Preliminary statement of the problem

Availability of relatively cheap labor allows Indonesia to compete successfully in rubber production with Malaysia and Thailand, the two other leading producers of rubber. In Indonesia, the majority of rubber is produced by smallholders in a 'jungle rubber' environment. In contrast, rubber production in Malaysia and Thailand is based on government-sponsored improved germplasm (adapted clones) and an estate-style management (i.e., a high-input and high-output system). Most farmers in Indonesia cannot afford a government-subsidized loan to purchase adapted clones and extra labor and cash requirement for the maintenance of these clones. But, the government of Indonesia wants to improve rubber yields using high-yielding clones.

The optimum level of weeding and fertilization requirement needs to be assessed in systems that can be compromised with existing low-input and low-output 'jungle rubber' agroforestry systems. Whether or not adapted clones can compete successfully with the secondary forest regeneration also needs to be investigated.

Scope of the investigation

It is limited to the questions that can be researched within my six months of stay in Indonesia. However, the outcome can be broadly applied to other RAS to improve the farmers' income and the output of the system.

Specific objectives (based on unanswered questions)

1. To examine the relationship between light availability at or near the ground and weed vigor/composition
2. To monitor if there is any effect of weeding on weed vigor/composition
3. To assess the change in SOM and soil nutrient availability caused by weeding

Hypotheses or tentative solutions (match with foregoing objectives)

1. Different kinds of weed would be associated with different levels of light availability. Weed biomass would decrease as light availability becomes less.
2. Weed biomass production per unit time would decrease and species composition of weeds would change as the frequency of weeding increases.
3. Increase in the number of weeding would decrease SOM and increase soil nutrient (N, P, and K) availability as the nutrients formerly absorbed and locked up by weeds become available.

Study procedures (how I go about testing the foregoing hypotheses)

1. Light availability at or near the ground, in terms of the photosynthetic photon flux density (PPFD), can be measured by a PAR sensor and compared if there are many stands with different age groups that have been receiving similar management treatments (similar weeding and fertilizer application level and past site history). Measurements can be taken on crown diameter, crown depth, leaf area index (LAI), DBH, canopy coverage, and stand density to characterize the stands. At the same time, ground cover vegetation will be recorded and biomass measurement will be taken from a randomly placed quadrangle (50 cm x 50 cm). Then, the light availability data can be correlated with the ground cover species (weed population) data to see if there is a relationship between the existence of certain ground vegetation and the availability of light. The result will have a management implication.

2. A weeding treatment is assigned randomly to each plot. Ground cover vegetation will be recorded and biomass samples will be taken from the randomly placed quadrangles within a plot. The vegetation samples will be dried in an oven for dry weight determination.

3. Soil samples will be taken randomly from each plot under different weeding management. The samples will then be analyzed for soil nutrients and SOM using the ion exchange resins technique (or $H_2SO_4/H_2O_2/Se$ digestion for total N and P) and the "wet" oxidation method measuring the unreacted dichromate by colorimetry, respectively.

Experimental Setup

RAS 2 is between 1.5-3 years old.

Treatments

Weeding frequencies and methods will be decided in a participatory meeting with farmers. Sandra (1995, 1996) used the following treatments agreed by the farmers.

1. Control: weeding nine times a year, 1m on either side of the trees along the entire length of the rubber tree row. Legume cover crops in the inter-row. Prescribed 'standard' plantation management conditions (TCSDP).
2. Low weeding level: weeding four times a year, 1m on either side of the trees along the entire length of the rubber tree row.
3. Intermediate weeding level: weeding six times a year, 1m on either side of the trees along the entire length of the rubber tree row.
4. High weeding level: weeding nine times a year, 1m on either side of the trees along the entire length of the rubber tree row.

Layout

A weeding treatment is assigned randomly to each plot.

Kind of data required

1. Characterization of a stand: LAI, crown diameter, crown depth, DBH, canopy coverage, and stand density
   Light availability: PPFD at or near the ground (inter-row spaces where weeding takes place)
   Ground cover: weed biomass weight (dry), weed community composition by species
2. Weed biomass weight (dry), weed community composition by species
3. Soil samples, later analyzed for the SOM content and the nutrients (N, P, and K) level

ANNEX 14

ASB seminar ICRAF

Day One, Sunday, August 17, 1997

Participants:	Affiliation:	Ecoregion:
Samuel Oliveira	EMPRABA	Brazilian Amazon
James Gockowski	IITA	Cameroon forest margins
Theo Tiki-Manga	IRAD	Cameroon forest margins
Sam Fujisaka	CIAT	Peruvian Amazon
Ricardo Labarta	ICRAF	" " "
Tom Tomich	ICRAF	Sumatran lowland diptocarp forest
Anne Marie Izaac	ICRAF	global
Markus Walsh	ICRAF	global
David Thomas	ICRAF	Thailand highland forests
Steve Vosti	IFPRI	Brazilian Amazon
Fred Stolle	ICRAF	Sumatran lowland diptocarp forest
Suseno	ICRAF	" " " " " "

Working Group Chair--Anne Marie Izaac
Rapporteur--James Gockowski

The meeting began at 8H30. The Indonesian members of the working group were unable to attend because of National Independence day celebrations.

Summary of day one outputs

The chief outputs of the first day's meeting were a proposed agenda for the 4 remaining days and outputs to be provided by the working group for the GEF final report. A listing of possible characterisation activities for the remaining phase of ASB was also developed.

Proposed agenda for days 2 through 5 of characterisation working group

1. Presentations (bone marrow only) — **Monday am**
   Cameroon, Brazil, Indonesia (15 minutes plus 5 minutes discussion)
   - driving forces
   - types of slash and burn agriculture
   - production objectives
   - principal constraints to the adoption of best bet alternatives
   - priorities for interventions in terms of themes and spatial patterns.

   Best bet matrix (Vosti and Tomich)
   Biodiversity measures in Cameroon and Amazon (Tiki-Manga and Fujisaka)
   Spatial extrapolation domains (Walsh)

2. Extrapolation domains — **Monday pm--Tues pm**
   a) for Global Environmental Facility, b) for developmental phase of ASB

3. Predictive models, simulations — **Wednesday am**

4. a) Backstopping characterisation in new sites — **Wednesday pm**
   b) Briefing of current activities in new sites
   Peru, Mexico, Thailand, Madagascar, Philippines

5. Identify key gaps for possible future action — **Thursday am**
   (data, training, education, links to decision makers)

6. Strategies to address key gaps — **Thursday pm**
   (proposals, collaborations, . . . ?)

<u>**Outputs for GEF final report** (to be submitted to the linkages working group prior to their meeting in November)</u>

In a perfect world the characterisation group would provide to GEF the environmental consequences (carbon sequestration, biodiversity, and GHG emissions) of the five best bets under a series of different adoption scenarios.

What can we realistically deliver is the following:

1) Assess the C sequestration and gas emission effects of current existing land uses at benchmark scale and if feasible at other scales. The question was put forth as to whether or not it would be desirable to include any information forthcoming from the other newer sites. Suggestion was rejected---GEF didn't fund these. The responsibility for this output is to be the local benchmark teams plus Markus Walsh. The Amazon biodiversity data which were measured through standard sampling techniques and species counts could be included in this baseline characterisation. (The first round of Cameroon biodiversity was sampled in a similar fashion). It was suggested that Andy Gilliason be contacted to see if this would present his working group any problems. Tiki-Manga and Fujisaka were to present information on the data sets for Cameroon and Peru/Brazil respectively.

2) At each site evaluate carbon seq. and gas emission effects of at least one "best bet candidate alternative" (BBCA) if adopted at benchmark scale (and perhaps beyond if data permit). This also is to be done by local teams, and is to include sensitivity analysis on spatial adoption patterns.

Certain issues were raised concerning extrapolation domain delination (proposed agenda item 2) that are important for today's meeting and so have been pulled out of the complete set of notes from yesterday which are still being edited.

⇒ Meeting began with the chair in the role of devil's advocate, questioning the representativeness of the sites in Brazil and Peru for the Amazon river basin, the Cameroon benchmark for the Congo basin and Indonesia for the lowland diptocarp forest. How representative are the various scales within the benchmark all the way down to the household scale of the larger ecoregion?
⇒ How to bridge the different scales--plant and plant microenvironment, field, landscape, household, village, ecoregion, national, global.
⇒ Ecoregional approach of EPHTA provides a characterisation methodology for the development of (1) research and development domains within benchmarks, supplemented by (2) pilot sites for verification and adaption of technology innovations (specifically crop and natural resource management innovations) and most importantly (3) the delination of extrapolation domains through use of lower resolution spatial characterisation across the identified ecoregion corresponding to the benchmark.
⇒ It was pointed out that the land use suitability was a necessary but not sufficient for domain delination. Other elements could include markets, policy environment, institutional development, infrastructure, land, capital, and labor endowments etc.
⇒ Sites were chosen to be representative, therefore we need to assume we can extrapolate to whole of tropical rainforest.
⇒ Funding proposal might be developed for extrapolation domain definition across benchmark area.
⇒ What is (are) the extrapolation domain(s) for the benchmark areas.

International Centre for Research in Agroforestry

ICRAF

Copies to: HdF/GM GV EP FS/RB CF

To:	**All ASB/GSG Members**
From:	Chip Rowe **ASB Coordinator, ICRAF**
Date:	31 January, 1997
Subject:	**6th ASB Global Steering Group Meeting - Bogor, Indonesia**

Dear Colleagues,

This is to give you advance notice of the next ASB Global Steering Group Meeting and associated activities. Dr. Achmad Fagi of AARD, Bogor, Indonesia has very kindly offered to host the meeting which takes place from August 23 to 27. The meeting will start with field visits. You will have the choice of going to either Jambi or Lampung in Sumatra. We will provide a description and itinerary of both visits in due course and ask you which one you would like to join. The field visits will take place from 23rd to 25th followed by a two day GSG meeting on 26th and 27th.

Prior to the Sumatra visits, four of the five ASB Working Groups will meet in Bogor:

August 18&19	Characterization & Global warming	Monday/Tuesday.
August 20&21	Biodiversity & Training/Information	Wenesday/thursday.
Thursday 21 6³⁰ PM : welcoming ceremony.		
August 22	Four WGs finalize their conclusions for presentation to the GSG	Friday.
22 to 25 : field trip Sumatra.		

The working groups are split like this because six people are in two working groups. Just to remind you, the compositions of the four working groups are as follows:

Characterization	Anne-Marie Izac, Achmad Fagi, Theophile Tiki Manga, Sam Fujisaka, Soetjipto Partohardjono, Tom Tomich. + Eric Penot
Global warming	Cheryl Palm, Paul Woomer, Jean Kotto-Same, Daniel Murdiyarso, Kurniatun Hariah, Meine van Noordwijk, Carlos Castilla.
Biodiversity	Andy Gillison, Jean Tonye, Theophile Tiki Manga, Sam Fujisaka, Mike Swift, Stephan Weise, Robert Simanungkalit, Meine van Noordwijk, Soetjipto Partohardjono, Tom Tomich.

United Nations Avenue, Gigiri, PO Box 30677, Nairobi, Kenya
Telephone: (254-2) 521450; Telefax: (254-2) 521001; Telex 22048 ICRAF; E-mail: icraf@cgnet.com; HTTP://WWW.CGIAR.ORG/ICRAF

Training and Information Ester Zulberti, James Gockowski, Segundino Foronda, David Thomas, Kurniatun Hariah, Daniel Murdiyarso

The fifth Working Group will meet in Nairobi from September 20-27 after ICRAF's Annual Programme Review (APR) meeting (7-20 September). The following persons are members of the Working Group:

Linkages David Thomas, Chimere Diaw, James Gockowski, Jean-Luc Khalfaoui, Stephan Weise, Mike Swift, Achmad Fagi, Tom Tomich, Cheryl Palm, Dennis Garrity, Walter Bowen, Meine van Noordwijk, Steve Vosti.

With warm regards,

Chip Rowe
ASB Coordinator, ICRAF

cc: Pedro A. Sanchez

CR/jk

2nd DRAFT

6th ASB Annual Review Meeting (ARM)
23 - 27 August, 1997
Bogor, Indonesia
Daily Schedules

Friday 22

	Activity	Responsible
PM (time to be arranged)	**Introduction and Welcome** • Welcome Statement • Field Visits (Briefing)	P. Sanchez (Chair) High level GOI official and/or Achmad Fagi, AARD Dennis Garrity and both tour leaders
Tuesday 26	**Activity**	**Responsible**
08:00-09:00	**Opening of ASB Annual Review Meeting** • GSG Chairman's Report • UNDP comments • ASB Coordinator's statement *Rapporteur*	Achmad Fagi, AARD (Chair) Pedro Sanchez Phil Reynolds Chip Rowe Catherine Kenyatta
09:00-10:00	**PLENARY SESSION I: TRAINING & INFORMATION WORKING GROUP: FINDINGS & CONCLUSIONS (1½hrs)** • Presentation by chair person **(30 min)** • Discussion **(30 min.)**	E. Zulberti (Chair)
10:00-10:30	 **COFFEE BREAK** **Group Photograph**	
10:30-11:00	**PLENARY SESSION I: CONTINUED** • Discussion **(20 min.)** • Summary & Conclusions **(10 min.)** *Rapporteur*	E. Zulberti Catherine Kenyatta
11:00- 12:00	**PLENARY SESSION II: BIODIVERSITY WORKING GROUP: FINDINGS & CONCLUSIONS (2hrs)** • Presentation by chair person **(30 min)** • Presentation by TSBF (*Below-ground biodiversity)* **(30 min)** • Discussion **(30 min)**	Andy Gillison (Chair) Mike Swift
12:30-14:00	 **LUNCH**	
14:00- 14:30	**PLENARY SESSION II: - CONTINUED** • Discussion **(20 min)** • Summary & Conclusions **(10 min)** *Rapporteur*	Andy Gillison Catherine Kenyatta

14:30-16:30	**PLENARY SESSION III: GLOBAL WARMING WORKING GROUP: FINDINGS & CONCLUSIONS (2hrs)** • Presentation by chair person **(30 min)** • Discussion **(1hr 20 min.)** • Summary & Conclusions **(10 min.)** *Rapporteur*	 Cheryl Palm (Chair) Cheryl Palm Catherine Kenyatta
16:30-17:00	**COFFEE**	
17:00-19:00	**Closed Session of GSG** *Rapporteur*	P. Sanchez (Chair) Chip Rowe
19:30	**DINNER**	GOI/AARD
Wednesday 27	**Activity**	**Responsible**
08:00-09:30	**PLENARY SESSION IV: CHARACTERIZATION WORKING GROUP: FINDINGS & CONCLUSIONS (1½hrs)** • Presentation by chair person **(30 min)** • Discussion **(50 min.)** • Summary & Conclusions **(10 min.)** *Rapporteur*	 Anne-Marie Izac (Chair) Anne-Marie Izac Catherine Kenyatta
09:30 - 10:00	**COFFEE BREAK** **Poster Session**	
10:00 - 12:30	**PLENARY SESSION V: ASB PHASE III: THE WAY AHEAD (2½HRS)** • Strategy • Institutional/operational structure for Phase III • Implementation of Strategy • Discussion **(50 min)** • Conclusions **(20 min)** *Rapporteur*	 P. Sanchez (Chair) P. Sanchez Chip Rowe P. Sanchez Catherine Kenyatta
12:30 - 14:00	**LUNCH**	
14:00 - 17:00	**PLENARY SESSION VI: CONCLUSIONS (3hrs)** • Report on outcome of closed session • Implications of ARM conclusions on the content of future Regional Activities **(10 min. each)** ♦ Southeast Asia ♦ Cameroon ♦ Latin America • Implications of ARM conclusions on the Syntheses/Linkages Working Group's agenda and expected outputs followed by discusion • Prospects for future funding • Where do we go from here - discussion • Closing remarks *Rapporteur*	P. Sanchez P. Sanchez Achmad Fagi Stephan Weise Dale Bandy David Thomas Chip Rowe P. Sanchez P. Sanchez Catherine Kenyatta

Revised : July 12, 1997

Southeast Asia Regional Research Program
Regional Planning Meeting

August 28 & 29, 1997

Tentative Program

Thursday, August 28

0800	Registration	
0830	Opening Session	
	Setting the stage and regional perspective	D Garrity
	ASB Regional Perspective	A M Fagi
	APAN Regional Perspective	Chun Lai
	The Country Perspective	
0930	ASB in Indonesia	A M Fagi
0945	APAN in Indonesia	A N Gintings
1000	Discussion	
1010	Coffee break	
1030	ASB in Thailand	
1045	APAN in Thailand	Teunchai
1100	Discussion	
1110	ASB in the Philippines	S Foronda
1125	APAN in the Philippines	C Diaz
1140	Discussion	
1150	ASB in Vietnam	Do Van Hoa
1205	APAN in Vietnam	N.H. Nghia
1220	Discussion	
1230	Lunch	
	Natural Resource Strategies and Policy	
1345	Research Program Overview/ ADB regional policy project	D Thomas
1400	Land tenure/ancestral domains (SANREM)	Chip Fay
1410	Agroforest community management	Tri Nugroho/ Hubert de Foresta
1420	Alternative forest products	Genevieve Michon
1430	Discussion	
	Agroforestry Tree Domestication	
1500	Overview of strategy and plans for workshop	J Roshetko
1515	Discussion	
1530	Coffee break	

Ecosystem Rehabilitation

1600	Research Overview	M van Noordwijk
1620	Modeling complex agroecosystems	Daniel Murdiyarso
1630	Erosion modeling at the landscape scale	Ed Paningbatan/ Machfudh
1640	Biological management of soil fertility	Kurniatun Hairiah
1650	Discussion	

Agroforestry Systems Improvement

1700	Research overview	D Garrity
1715	Indigenous strategies to intensify shifting cultivation	M Cairns
1730	Rubber agroforestry	GeDe Wibaw
1745	Discussion	
1755	Working groups announced	
1800	Adjourn	

Friday, August 29

Training, Information, Dissemination

0800	Overview: TID and new Development Division thrust	E Zulberti
0815	APAN/ICRAF interface: Building synergy	Chun Lai
0830	S E Asian Agroforestry Education Network	R. del Castillo
0845	Discussion	

0900 Working groups by program
Develop priority thrusts for 1997-98
Refine regionwide institutional linkages by activity
Sharpen activity protocols for implementation

[Coffee served during group meetings]

1030 Plenary Session on Program Thrusts for 1997-98:
Group Reports and Discussion

1130 Break

1330 Working groups break out by country
Develop priority thrusts for international collaboration
Refine the protocols and institutional links for implementation
Discuss strategies to mobilize resources for national aspirations

1530 Break

1600 Plenary session on Country Plans:
Reports and Discussion

1700 Plenary Session on Collaboration at the Regional and Global Levels
Examine international linkages to strengthen local efforts

1800 Closing

ANNEX 15

Proposal for a new RAS 4 trial

→ Ngrg, Hube
Tom, En
Rien, De

Protocol RAS 4.1: Tree Protection for Gap Rejuvenation of Rubber Agroforests

Objective

Rubber agroforests can be rejuvenated by slash-and-burn clearfelling and replanting at field-scale (as in RAS 1, 2 and 3), or in a patch-wise proces by managing regeneration in gaps, after transplanting young rubber trees (seedlings or clones) or by direct seeding. Problems for the young rubber trees will be formed by predation by wild pigs and monkeys, as well as shading by existing vegetation and competition for water and nutrients. Plant-plant interactions will undoubtedly retard the growth of the young rubber, but this may be acceptable to the farmer as long as the surrounding vegetation is still productive. The risks of disturbance of young rubber by pigs and monkeys are a prime concern of farmers and we will focus on a test of simple protection mechanisms as a first step. Later research can include gap size and light environment as experimental factors. For the first year we will test the following hypotheses:

Hypothesis 1. Physical protection of young rubber trees by bamboo shafts and or spiny stems of rotan or salak can reduce damage by wild pigs to less than 10% when clonal rubber trees are planted out in gaps in existing rubber agroforests

Hypothesis 2. Combined planting of cinnamon and young rubber trees allows rubber to benefit from the repellant effect of cinnamon and can thus reduce damage by wild pigs to less than 10% when clonal rubber trees are planted out in gaps in existing rubber agroforests

Both hypotheses will be tested with an 'unprotected' control, where we expect pig damage to be so high (> 50%) that investment in clones would not be feasible for farmers.

Supporting evidence for hypothesis 1 is found in the experience in some of the earlier trials, where incomplete fences around the field could be compensated by the use of bamboo shafts. Some preliminary trials with spiny stems suggests that they may be effective as well.

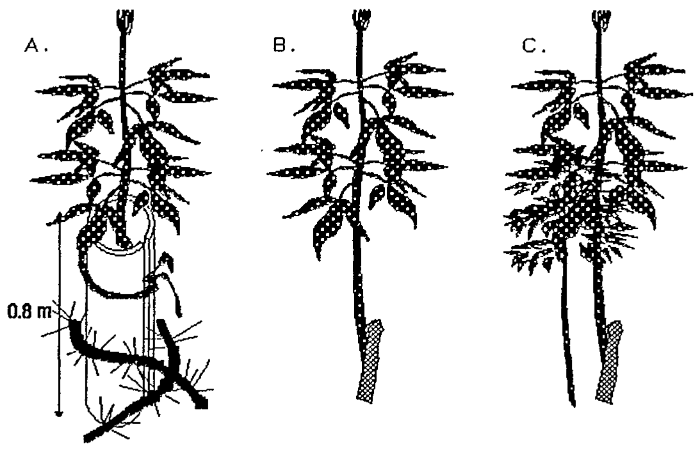


Figure 1. Three methods of planting rubber trees: A. with physical protection, B. direct, C. in close assocuation with cinnamon

Hypothesis 2 is based on the observation that cinnamon trees are not disturbed by pigs, in fields where pig damage to rubber is high. Planting the two trees close together may yield protection to the rubber trees; competition effects may be small in the first two years, and afterwards the cinnamon can be removed.

Site selection

As selection criteria for agroforests to be included in the trial we'll use:

- low density (100 - 200 trees/ha) of trees which are still productive (if there are no productive trees left, gap rejuvenation is probably too slow for the farmer, if there are more trees it may not be needed),
- reasonably open canopy, where enough gaps can be found without much pruning of the existing trees,
- steep slopes are acceptable, as long as the plot will be accessible for tapping later; on steep slopes gap rejuvenation may be the preferred method as it reduces erosion hazards of field-level clearing,
- size at least 1 ha, allowing a sufficient number of trees to be planted (30 - 45 per forest) for a comparison of three treatments with 10-15 trees each,
- farmer has no plans for clear-felling of the plot, is interested in gap rejuvenation and understands the idea of a comparison of treatments.

Design

We will select 4 farmers/ agroforest plots, and plant 30-45 trees in each. Planting material should be large-sized material (2 whorls of expanded leaves, 'payung') from polybags (to give a chance for rapid establishment). At planting time soil disturbance will be minimized to reduce risk of attracting pigs; sites for planting will not be close to a major footpath (again to reduce risk of pigs finding the young rubber). Suitable planting sites will be identified prior to random allocation of treatments to individual trees. On some of the plots a randomized block design may be used, if blocks can be distinguished, e.g. with respect to distance to the edge of a plot, and/or slope categories.

4 Agroforests * 3 Blocks/agroforest * 3 Treatments/block * 5 trees/treatment = 180 trees

Per treatment this will give 60 trees; at the target survival rate of 90%, (4) - 6 - (8) trees may be lost.

Farmers will have an input in the implementation of the methods A and C, but we should maintain a comparison of A and C against an unprotected control (B). The project will provide the rubber planting material and will select the planting locations together with the farmer.

Parameters

During the first year we will only monitor damage to and survival of the young trees, once every 3 months (we should not create a path to or opening around the trees). Farmer observations on the experiment will be inventoried, and jointly analyzed. After 1 year height and diameter of surviving trees will be measured, as well as the light environment at the level of the youngest whorl of leaves.

ANNEX 15

The new programme 4 of ICRAF
and
ICRAF Southeast Asia Regional programme

Final draft comments to Yay

ICRAF

Agroforestry Research in Southeast Asia by ICRAF

ICRAF's S.E. Asia Research Programme was initiated in 1992 as part of ICRAF's overall objective '...helping to mitigate tropical deforestation, land depletion and rural poverty through improved agroforestry systems'. ICRAF has a division for research and a division for development , which includes training, information and dissemination.

The research division is organized in three programs:

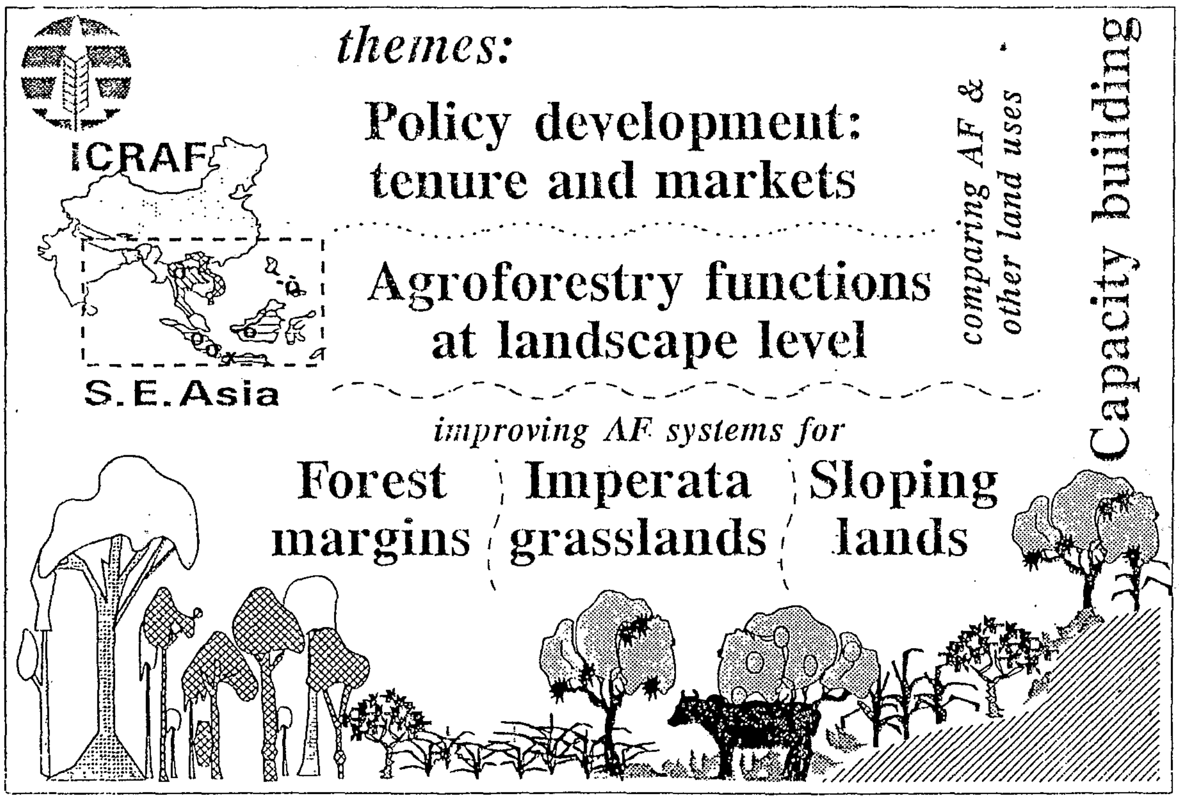
1. Natural Resources Strategies and Policy - studying existing agroforestry systems in their interaction with factors such as markets, government policies and the physical environment
2. Domestication of Agroforestry Trees - looking at ways farmers can manage and improve the tree germplasm used in agroforestry systems
3. Ecosystem Rehabilitation - focussing on the tree-soil-crop interactions in various agroforestry systems and landscape fuctions of agroforestry systems

The development division consists of:

4. Systems Evaluation and Dissemination - comparing existing and 'improved' versions of agroforestry systems and through a process of on farm testing feeding them into the 'real' world' as studied in program 1.
5. Capacity and Institutional Strengthening

For the Southeast Asia program, three priority ecosystems have been identified:

A. Forest margins or zones of current forest conversion; here we focus on 'complex agroforests' as sustainable alternative to destructive slash-and-burn systems based on annual food crops only,
B. *Imperata* grasslands, where small-scale agroforestry methods can contribute to reclamation of currently underutilized land, and
C. Hill slopes, where naturally vegetative strips and contour hedgerows can intercept eroding material and contribute to erosion control.



The global program initiative on 'Alternatives to Slash and Burn', or ASB was started in 1994 to search for sustainable alternatives to slash-and-burn agriculture, funded through the Global Environmental Facility (GEF), with Phase I activities in Indonesia, Brazil and Cameroon. The objectives are to reduce deforestation to protect biodiversity and the global C balance, by helping farmers to find sustainable, long term livelihoods as alternatives to unsustainable forms of slash-and-burn agriculture, and by helping governments to develop policies which facilitate such transformation. In Indonesia the peneplain zone of Sumatra was chosen as a focus of interest, with research sites in Jambi (low population density, forest margin) and North Lampung (high population density on similar soil, degraded lands. Associated research is carried out in Krui (West Lampung) and in West Kalimantan.

ICRAF-S.E. Asia staff list

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REGION:-S.E. ASIA

1. Countries: Indonesia, Thailand, Philippines, Vietnam

2. ASB Co-ordinator: Dr. Ahmad M. Fagi

3. Budget 1998: US$ 2 135 k + 730 k = 2 865 k

4. Secured Funding

Donor	US$'000
IDRC: fallow strategies	75
ADB - policy research	500
EU - NTFPproject	60
Ford Foundation - Various	95
Total secured funding	730

5. Regional objectives (what do you want to do)

- Integrated economic and environmental impact assessment of land use change in forest margins and degraded lands, combining farmer, environmental , downstream and regional effects; emphasis on the conditions under which complex agroecosystems can emerge as best-bet solutions and integrated analysis of driving forces
- Assessment of farmer technology development, local institutions and policy changes needed for successful natural resource conservation and rehabilitation of degraded lands
- Develop technical, institutional and policy recommendations on how rubber agroforestry systems can remain attractive as alternatives to plantation monoculture development as well as to food-crop based slash-and-burn systems, combining environmental benefits and productivity
- Assessment of ecological, social and economic impacts of the three main production systems for 'non-timber forest products (NTFP): extraction from natural forests, agroforests and monoculture plantations
- Evaluation of the five most promising indigenous fallow management methods identified by work done in 1997 to judge their scope for extension
- Evaluation of existing community watershed mosaic systems and fruit tree agroforestry systems for improved management in protected watershed zones
- Develop technical, institutional and policy options for smallholder timber production and conservation farming strategies for bufferzone management outside national parks

6. Programmatic highlights (what have you done so far?)

- Completed biophysical, community and household characterization of benchmark areas in the lowland peneplain and foothill (piedmont) zone of Sumatra, identifying driving forces of land use change, farmers 'best bet' choices and priorities for further research (ASB-Phase 1)
- Established an integrated methodology for characterization and assessment of biodiversity values, C-stocks, net greenhouse gas emissions, agronomic sustainability and economic profitability for dominant and 'best-bet' land use systems in forest margins and degraded lands (ASB-Phase 2)

- Initiated a synthesis of our understanding of the role of migration and large projects in land use change in the forest margin
- Published analysis of economics and policy implications of conversion of Imperata grasslands to tree-based systems, including assessment of C-sequestration values
- Policy dialogues have lead to acceptance by policy makers at the highest level of options for more effectively meeting policy objectives regarding poverty alleviation and environmental protection, including biodiversity conservation and reduction of GHG emissions
- Developed a solid corpus of scientific knowledge about indigenous agroforests and their ecological, social and economic benefits, as well as their potential and constraints for further development
- Implemented a network of over 60 on-farm trials to evaluate 'domesticated' tree germplasm with minimum management intensity for smallholder rubber agroforestry on forest margins and Imperata grasslands
- Regional synthesis of promising indigenous strategies to intensify shifting cultivation; organized a regional network to refine and extrapolate the best strategies through extension systems
- Initiated on-farm trials to evaluate timber species performance by participatory appraisal of farmer experiments; initiated a local-government-led extension model for conservation farming
- Initiated catchment-level analysis of land use change and evaluation of promising agroforestry options in a protected watershed zone
- Established the Jambi transect as one of the major study areas for global change research by GCTE-IGBP, building on research initiated by the ASB consortium

7. Outputs (your deliverables for 1998)

- Published results and evaluation of the rapid biodiversity assessment results of ASB-Phase 2
- Published analysis of environmental and economic values of dominant and 'best-bet' land use alternatives for the forest margins, testing the hypothesis that agroforestry systems are superior from a multiple-objective perspective
- Published analysis of direct fire impacts on soil organic P and soil biota in the context of changing 'slash-and-burn' to 'slash-and-mulch' systems
- Experiments to test hypotheses on the role of agroforest soils as sink for methane
- Initiation of a network of on-farm trials with a range of tree crops in *Imperata* grasslands
- Publication of initial results of on-farm trials on the introduction of domesticated rubber tree germplasm into low-management intensity rubber agroforestry systems; a validated model of tree-soil-crop interactions which can be used to explore further management options
- Analysis of trade-offs between profitability, agronomic sustainability and environmental impact of different management options for agroforests
- Analysis of trade-offs among profitability, agronomic sustainability and environmental impacts of different management options for protected watershed zones
- Inventory of farmer knowledge and first release of an ecological model of tree-tree interactions in complex agroforests, as basis for farmer management options, including timber harvesting; feasibility study of sustainable timber production in agroforests
- Initiation of a network of trials to further define and refine five most promising strategies to intensify shifting cultivation in four countries of S.E. Asia
- Policy dialogues in three countries on the institutional basis for community-based resource management; model agreements between government and local communities on joint management of state forest land as a first stage in developing productive and sustainable management of these dual-claimed lands
- Regional methodology workshop on measurement of environmental externalities

8. 1998 Action & commitment (depending on budget availability)

Activities	Professional staff months	Partners
(a) Characterization & GIS work		
Characterization of benchmark areas and drivers of deforestation and land use change in Thailand, Philippines and Vietnam	48	ASB-Thai,ASB-Phil,ASB-Viet, ICRAF
Analysis of environmental values and productivity of dominant and 'best-bet' land use alternatives for the forest margin	48	ICRAF, ASB-Ind, ASB-Thai,ASB-Phil,ASB-Viet
(b) Assessment of climate change implications of alternative land-use practices (greenhouse gas emissions, carbon stocks, etc.)		
Experiments to test hypotheses on the role of agroforest soils as sink for methane	12	ASB-Inc d, ICRAF
Analysis of direct fire impacts on soil organic P and soil biota in the context of changing 'slash-and-burn' to 'slash-and-mulch' systems	12	ASB-Ind, ICRAF
Refinement of the estimates of C stocks, focusing on agroforests as 'best bet' land use option	24	ASB-Ind, ICRAF
Assessment of carbon sources and sinks and GHG emissions of upland systems at benchmark sites in North Thailand	12	ASB-Thai, ICRAF, TSBF
(c) Assessment of impact of different land-use practices on above- and below-ground biodiversity		
Assessment of above- and belowground biodiversity in a range of land use types (dominant current and 'best bet') as a follow up to ASB-Phase 2; the foot-hill zone will be added to the previous analysis which focused on the lowland peneplain only	48	CIFOR, TSBF, ASB-Ind, ICRAF
Evaluation of the need to restore microbial symbionts as part of the reclamation of degraded lands by tree crops	12	ASB-Ind
Assessment of above- and belowground biodiversity of upland systems at benchmark sites in North Thailand	24	ASB-Thai, CIFOR, TSBF, ICRAF
(d) Assessment of the biophysical aspects of improved agroforestry systems		
Testing existing landscape level models of soil erosion in the Batanghari watershed (Indonesia) and benchmark sites in North Thailand	36	ASB-Ind, ASB-Thai, ICRAF
Inventory of farmer knowledge and first release of an ecological model of tree-tree interactions in complex agroforests, as basis for farmer management options, including	24	ICRAF/ORSTOM, ASB-Ind

timber harvesting		
Continue on-farm trials on the introduction of domesticated rubber tree germplasm into low-management intensity rubber agroforestry systems; a validated model of tree-soil-crop interactions which can be used to explore further management options	36	ICRAF, CIRAD, ASB-Ind
Initiation of a network of trials to further define and refine five most promising strategies to intensify shifting cultivation in four countries of S.E. Asia	36	ICRAF, ASB-Phil, ASB-Thai, ASB-Viet, ASB-Ind
Regional methodology workshop on measurement of environmental externalities (siltation, flooding, water shortage, smoke) arising from various land use systems	12	ICRAF, ASB-Phil, ASB-Thai, ASB-Viet, ASB-Ind

(e) Assessment of socio-economic factors affecting the adoption of improved agrofor estry systems		
Analysis of links between migration, deforestation and land degradation	24	ASB-Ind
Assess community watershed mosaic agroforestry systems and fruit tree agroforestry for improved management of protected watershed areas	24	ASB-Thai, ICRAF
Assess community forestry options for improved forest management	36	ASB-Ind, ASB-Thai ASB-Phil
Continue farmer-lead evaluation of timber production systems for elevation ranges in bufferzones of protected ecosystems	36	ASB-Phil, ICRAF
(f) Development of proposals for incorporation of 'best-bet' alternatives in country action plans		
Policy dialogues in three countries on the institutional basis for community-based resource management	36	ICRAF, ASB-Ind, ASB-Phil, ASB-Thai
Scale up results of the local-government-led extension model for conservation farming in the Philippines	12	ASB-Phil, ICRAF

ASB-Ind, ASB-Phil, ASB-Thai and ASB-Viet stand for consortia of national research institutes, universities and NGO's in Indonesia, Philippines, Thailand and Vietnam, respectively

Total 46 professional man years of researchers (roughly: ASB-Indonesia 14, ASB-Thailand 9, ASB-Philippines 6, ASB-Vietnam 3, ICRAF 11, CIFOR 2, TSBF 1 new programme 4

Systems Evaluation and Dissemination:
A New Project Structure and Generic Research
And Dissemination Activities

DRAFT

To be presented to ICRAF's Board of Trustees

Wednesday 3rd November 1997

Contents

BACKGROUND: THE EVOLUTION OF THE SYSTEMS IMPROVEMENT PROGRAMME (1993-1997) 1

RATIONAL FOR A CHANGE IN PROJECT STRUCTURE 3

NEW PROJECT STRUCTURE AND OBJECTIVES 3

PERCEIVED ADVANTAGES OF NEW STRUCTURE 6

GENERIC ACTIVITIES IN SYSTEMS EVALUATION AND DISSEMINATION 6

ANNEX 1. OBJECTIVES AND TASKS OF GENERIC ACTIVITIES IN
SYSTEMS EVALUATION AND DISSEMINATION RESEARCH I

Systems Evaluation and Dissemination: A New Project Structure, and Generic Research and Dissemination Activities

Background: The Evolution of The Systems Improvement Programme (1993-1997)

During the past 5 years, the Systems Improvement programme has evolved, both with respect to its own mandate and it's collaborative interaction with other ICRAF Programmes, particularly Programme 1, now entitled "Natural Resources Strategies and Policy".

In ICRAF's MTP "Agroforestry for Improved Land Use", (March 1993), the goal of the Systems Improvement Programme was stated as:-

> **"To undertake monitoring and evaluation of the long-term biophysical ecological and economic impact of AF technologies used as alternatives to current systems".**

This adaptive research was largely undertaken on-station with some researcher designed and managed on-farm trials. The output of this work was stated as:-

> **"the production of recommendations for technologies to be tested on-farm in collaboration with scientists in ICRAF's Project 1.2, "Technology Testing".**

In the intervening period, 1993-1997, this position has altered as ICRAF has gained new insights and experience through working with farmers.

- Project 1.2 has moved away from on-farm testing of 'recommended' innovations and *ex post* analysis of adoption and impact. This has been in response to a perceived need to develop analytical tools to enable better targeting of AF innovations through an *ex ante* analysis of adoption factors and impact at different spatial scales. This has been reflected in changed objectives, of Project 1.2 which are currently:-

    - to **predict** the ecological, economic and social boundary conditions of AF for the mitigation of key natural resources management problems and poverty
    - to assess (**ex ante**) the potential ecological, economic and social costs and benefits of AF practices compared with alternative natural resources management options at different spatial scales.

- During the same period Programme 4 also broadened its mandate and began to undertake the bulk of its research in partnership with farmers in their fields through both researcher designed/farmer managed trials and through farmer designed and managed trials. This on-farm research is concentrated in Pilot Areas in the regions where ICRAF staff were based.

As the programme of on-farm research gained momentum in these pilot areas it became clear that a seamless continuum of activities existed which spanned across participatory systems evaluation, monitoring farmer adoption and impact at various scales, and the facilitation of the wider dissemination of successful AF innovations both within and beyond the geographical boundaries of the pilot areas. This recognition led ICRAF to the bold decision to become actively involved in playing a catalytic role in the dissemination of priority and successful AF interventions. This decision is clearly spelt out in ICRAF's new MTP (1997) in which a new Development Division has been created with a key pillar of "Accelerating Impact". The old "Systems Improvement" programme has been re-named "Systems Evaluation and Dissemination" and has become part of the Development Division.

The Systems Evaluation and Dissemination Programme has 5 principal aims, indicated in ICRAF's MTP (1997) which remain unchanged. They are:-

- **Provide a coordinated, monitored and analytical mechanism for the participatory evaluation of promising agroforestry practices**

- **Find best-bet management options of promising innovations and define their biophysical and socio-economic boundary conditions.**

- **Help integrate these successful agroforestry practices with other agroforestry and non-agroforestry land-use practices in farmers' fields and the landscapes to resemble successional agroecosystems**

- **Act as a catalytic and action-oriented group for the wider dissemination of such agroecosystems in and beyond pilot areas, working in close collaboration with governments, NGOs, development projects and farmer organizations**

- **Provide feedback to and generate analytical information for a wide range of audiences on successes, constraints, farmer adaptation, adoption and impact of agroforestry research.**

A range of partners is involved in achieving these aims. They include include national research and extension staff, NGO's operating in the pilot areas, farmer groups and farmers. Increasingly these collaborative groups are formalizing and coordinating their activities and are becoming cohesive Adaptive Research and Dissemination Teams (ARDT's). Meetings are held several times a year to report on research and dissemination findings, and to plan for the future. Common approaches are agreed upon and responsibilities for action are set for both participatory evaluation of promising innovations and their wider dissemination both within and beyond the pilot project area. These teams are becoming the key central mechanisms through which ICRAF reaches out to farmers.

These changes have resulted in a marked re-definition of the respective collaborative roles of Programme 4 and Project 1.2. The Programme 4 output is now defined as:-

- **"the development, participatory evaluation and dissemination of priority AF systems in selected pilot project areas across ICRAF'S six ecoregions".**

Information gained on adoption, impact and the delineation of recommendation domains from the work within these pilot projects becomes an essential input into the development and calibration of the analytical tools developed by Project 1.2. These tools are then used to assist in both a refined targeting of wider dissemination beyond pilot project areas, and in providing an *ex ante* prediction of both biophysical and socio-economic impact at a range of spatial scales.

Rational for a Change in Project Structure

In the past, the Programme had structured its projects on a regional basis with six projects corresponding to the six ecoregions in which ICRAF works. The rational for this structure was that the research was adaptive in nature and was based on regional priorities. As such, it was felt that regionally based projects provided an element of cohesion to the six ecoregional collaborative teams. This was enhanced by appointing a regional scientist as project Lead Scientist. In five out of the six ecoregions, this Lead Scientist was the Regional Coordinator.

Recent events have however given rise to a different perspective. Firstly, the creation of a modified matrix and the transfer of greater authority and responsibility to Regional Coordinators and their teams has provided a solid basis for the further development of strong and cohesive regional programmes. This, in itself, negates the need for regionally based projects in Programme Four. In addition, however, during both APR 1995 and APR 1996, ICRAF staff clearly expressed their desire to create informal working groups to exchange ideas and information on broadly defined themes which cut across regions and which had emerged as having global importance within ICRAF's research agenda. Many of these themes were associated with on-going research in Programme Four. Such working groups were established and "Theme Leaders" identified. By and large these groups never functioned as hoped because they had no institutional home or funds available to support intra-regional travel.

As a result of these events, Programme Staff spent considerable time during APR 1997 in discussing a new and more appropriate project structure. Our ideas were shared with ICRAF staff as a whole during plenary sessions and valuable feedback was obtained. The outcome of APR 1997 was:-

- The description of 5 new projects and their objectives
- The definition of "Generic Activities" undertaken in Systems Evaluation and Dissemination Research, and the identification of tasks associated with these Generic Activities.

These are described in more detail in the following sections.

New Project Structure and Objectives

Five new projects have been identified, namely:-

Project 4.1 AF Systems for Soil Fertility Replenishment and Maintenance
Project 4.2 AF Systems for the Production and Utilization of Fodder and Forage
Project 4.3 AF Systems for the Integration of High Value Trees into LUS
Project 4.4 AF Systems for Soil Conservation and Terrace Management
Project 4.5 Regional and Global Activities in Systems Evaluation and Dissemination

The first four projects address broadly defined AF Systems of global importance to ICRAF (see Table 1). They have the following common objectives:-

- To develop and evaluate with farmers in Pilot Project Areas environmentally sound and economically viable AF Systems for ………, and to determine their biophysical and socio-economic boundary conditions.

- To act as a catalyst to and facilitate the dissemination of such innovations in pilot areas of the regions.

- To monitor and analyse the adoption and impact of AF Systems for …. at the field, farm and community level within the pilot areas

- To create awareness of such successful AF innovations and support their wider dissemination beyond pilot areas through capacity enhancement and the provision of information for a range of clients

- To undertake within and across regional analysis and synthesis of lessons learned in the evaluation and dissemination of AF Systems for ………..

Project 4.5, "**Regional and Global Activities in Systems Evaluation and Dissemination**", deals with activities which span across those associated with Projects 4.1 to 4.4, and has the following objectives:-

- To analyse and synthesize ICRAF's global experience in Systems Evaluation and Dissemination Research

- To develop and document a range of guidelines for approaches, methods and models for key generic activities in Systems Evaluation and Dissemination Research.

- To provide effective regional and global coordination and backstopping of ICRAF's collaborative adaptive research and dissemination activities.

Table 1. System's Evaluation and Dissemination: Research Agenda, 1998

Project Title	Ecoregion						Global
	Humid Tropics			Sub-humid tropics		Semi-arid tropics	
	West Africa	Latin America	S.E. Asia	Southern Africa	E.A. Highlands	West Africa	
4.1). AF Systems for Soil Fertility Replenishment and Maintenance	• Short and long duration improved fallows	• Short duration single species fallows • Long-term multi-species enriched fallows	• Research on indigenous Improved fallows	• Improved Fallows • Relay cropping • Biomass transfer • Mixed Inter-cropping	• Improved Fallows • Biomass transfer • P-replenishment	-	Within and across regional analysis and synthesis
4.2). AF Systems for the production and utilization of fodder and forage	• Pasture production under trees plantations (New)	-	-	• Fodder banks for dairy • Improved grazing lands	• Fodder banks for dairy	• Fodder gardens for urban and rural livestock production	
4.3). AF Systems for the Integration of High Value Tree into LUS	• High value trees in multi-strata systems (New)	• Fruit and timber tree associations • Multi-species combinations for non-timber tree products	• Rubber AF Systems • Small-scale timber production	• Rotational Woodlots and Boundary Planting for Poles/fuelwood • Indigenous fruit trees	• Woodlots, boundary planting and contour planting of trees for timber, poles and fuel	• Parkland enrichment	
4.4). AF Systems for Soil Conservation and Terrace Management	-	-	• NVS for soil conservation and tree establishment	• Contour hedges for fodder	• Rehabilitation of degraded terraces • Contour hedges for fodder • Catchment studies on soil erosion loss	• Soil conservation through digettes (New)	
4.5). Regional/Global Activities in Systems Evaluation and Dissemination	✓	✓	✓	✓	✓	✓	Global Output

Perceived Advantages of New Structure

Compared with the old regionally based project structure, the new thematically based projects appear to have several advantages, namely:-

- Projects have more focused objectives, more precisely described activities and clearer outputs
- Projects reflect major opportunities for successful AF interventions across ICRAF's regions
- The new structure better describes both the regional and global aspects of Systems Evaluation and Dissemination research
- Projects provide a logical structure for across region information sharing and synthesis of results
- The new project structure is more in line with those of other Programmes, and is more amenable to ICRAF's new project/activity based budgeting system.

Generic Activities in Systems Evaluation and Dissemination

ICRAF is moving towards an activity based budgeting system, and it was therefore important to identify the key generic activities which the programme undertakes in collaboration with our partners. Although participatory evaluation and dissemination from a continuum of activities, these activities can be usefully grouped into those associated with systems evaluation research, where we work with a limited sub-sample of pilot project farmers, and those associated with dissemination activities where we reach out to a wider population of farmers within and beyond the pilot project area. A third group of activities was identified which cut across systems evaluation and dissemination. The outcome of this exercise identified 15 generic activities which are listed in Table 2. The objectives and specific tasks which fall within each category of generic activity were also identified, and are given in Annex 1.

Although not feasible for the 1998 budget, it is envisaged that this concept of generic activities will provide scientists and management an added degree of descriptive accuracy and budget development and monitoring in the future. Currently, budgets for activities are coded with a particular ICRAF project number. For example, the three activities of (a) on-farm evaluation of fodder banks (b) the production of a video tape on fodder bank management and (c) the preparation of a paper on fodder bank research or publication would all be allocated to Project 4.2. Utilizing the concept of generic activities and tasks, these activities would be assigned code numbers of 4.2.3, 4.2.7 and 4.2.12 respectively. If generic activity numbers are kept constant across regions and years, it provides ICRAF with a powerful tool to analyse and track how its resources are being utilized for any single or combination of activities.

Table 2: Generic Activities in Systems Evaluation and Dissemination

No.	Description[1/]
Systems Evaluation	
(1)	Area and Target Group Definition for Pilot Projects
(2)	Diagnosis of constraints/priorities for AF interventions
(3)	On-farm experimentation on AF Systems
(4)	On-Station experimentation on AF Systems
(5)	Definition of boundary conditions for AF Systems
Systems Dissemination	
(6)	Diagnosis/description of dissemination components
(7)	Dissemination and public awareness
(8)	Capacity building and empowerment
(9)	Monitoring and evaluation of dissemination
Cross-cutting issues	
(10)	Regional/Global Synthesis
(11)	Methodology Documentation/Development
(12)	Conferences/Workshops/Publications
(13)	Development/management of ARDT's
(14)	Backstopping regional/global research and dissemination
(15)	Programme/Project Coordination

[1/]Notes: In each of these 15 broadly defined generic activities, a range of specific "tasks" have been identified, and are listed in Annex 1.

ANNEX 1. Objectives and Tasks of Generic Activities in Systems Evaluation and Dissemination Research

ACTIVITY 1. AREA AND TARGET GROUP DEFINITION

Objective:

In conjunction with consideration of ecozone priorities, preferences of policy makers, mandates of NARs and logistical factors to identify priority pilot project areas for Systems Evaluation and dissemination research (Collaboration with Project 1.1)

Tasks:

- Assemble maps to identify which areas of the country are in the priority ecozone
- Assess preferences of policy makers and NARS collaborators concerning areas to work in
- Assess which areas are of most strategic interest (are representative of larger areas) and which are logistically possible to work in.
- Use secondary data and key informants to define main target groups, based on identification of biophysical and socioeconomic variables that are most likely to influence adoption in area.

ACTIVITY 2. DIAGNOSTIC SURVEYS (GENERAL AND SPECIFIC)

Objectives

(1) To better understand farmer livelihood strategies, problems and management practices so as to design appropriate innovations.

(2) To promote farmer participation in design

Tasks

- Development of objectives, hypotheses, and information needed to test hypotheses
- Development of questionnaires or topic checklists
- Design of sampling strategy
- Enumerator training and pre-testing of questionnaires/checklists
- Survey implementation
- Data entry, checking, tabulation, analysis, and interpretation
- Report writing

ACTIVITY 3. ON-FARM RESEARCH

Objective:

To undertake participatory evaluation of a range of AF innovations (species choice and management) which address priority concerns of farmers in pilot project areas (Collaboration Project 2.4)

Tasks

- Farmer-village selection
- Decisions with farmers on what to test
- On-farm testing (design, implementation)
- Characterization of participating farmers
- Monitoring on-farm trials (biophysical, feasibility, adaptations, acceptability)
- Profitability (cost and returns analysis)
- Adoption studies of project farmers
- Impact analysis at field, farm, community level of project farmers etc. etc.

ACTIVITY 4 ON-STATION RESEARCH

Objectives

(1) To monitor the long term biophysical and economic performance of AF innovations which address priority concerns of farmers in pilot project areas (Collaboration Project 3.1, 3.2, 3.3.).

(2) To design, establish, monitor and analyse trials which address key issues identified through farmer feedback from on-farm research (Collaboration Project 2.4).

Tasks

- Analysis of farmer-feedback
- Trial design, establishment and maintenance
- Biophysical and socio-economic monitoring
- Analysis and interpretation

ACTIVITY 5. DETERMINING BOUNDARY CONDITIONS

Objectives

(1) To identify biophysical and social economic boundary conditions for species choice and management options of new AF innovations

(2) To assess, *ex ante,* the potential impact of adoption of such innovations within and beyond pilot project areas.

Tasks

- Identify key biophysical and socio-economic variables identified in Activity 2 and/or monitored in Activity 3 which have the greatest influence on whether innovation is adopted
- For each variable, identify the range (in quantifiable terms) across which the innovation is or is not likely to be adopted (Collaboration Project 1.2)
- Assess the areas across countries and potential number of farmers to whom the innovation should be targeted through wider dissemination (Collaboration Project 1.4)
- Undertake *ex ante* analysis of impact of adoption at a range of spacial scales (Collaboration Project 1.4).

ACTIVITY 6. DIAGNOSIS/DESCRIPTION OF DISSEMINATION COMPONENTS

Objective

To facilitate effective dissemination of proven AF innovates through the identification of possible dissemination constraints and the description and documentation of dissemination components

Tasks

- PRA on key seed/seedling supply issues
- Description regional continuum of AF practices
- Description of "ICRAF" innovations
- Confirmation of boundary conditions for wider dissemination (see also activity 5)
- Classification/description of dissemination partners
- Documentation of current AF extension models

ACTIVITY 7. DISSEMINATION AND PUBLIC AWARENESS

Objective

To catalyze and accelerate effective dissemination of priority innovations through the timely and comprehensive provision of information

Tasks

- Preparation of dissemination materials (technologies, nursery management, farmer seed lots, species descriptions)
- Establishment and backstopping of national AF networks
- Publication of AF newsletters
- Development of slide series and videos
- Systematic feedback/response to media

ACTIVITY 8. CAPACITY BUILDING AND EMPOWERMENT

Objective

To enhance the ability of dissemination partners to evaluate, disseminate and monitor the adoption of AF innovations.

Tasks

- Establish an inventory of AF training needs at all levels
- Develop national/regional training models
- Conduct general and specific AF training at levels (e.g. training trainees, extensionists, farmer groups, policy makers etc.)
- Facilitate dialogue between all stakeholders.

ACTIVITY 9. MONITORING AND EVALUATION OF DISSEMINATION

Objective

To evaluate the success and constraints associated with the various dissemination pathways followed by the ARDT's worldwide.

Tasks

- Facilitate feed-back from farmers to research
- Establish comparative cost-benefit relationships for dissemination activities at all levels
- Record farmer contact, technology adoption, adaption and impact (Collaboration Project 1.4)
- Monitor sustainability of dissemination (e.g. ICRAF support, partner contributions, enabling policies etc).

ACTIVITY 10. REGIONAL/GLOBAL THEMATIC SYNTHESIS

Objective

To provide a comprehensive report on information gained, lessons learned and future areas of priority research through both inter and intra-regional synthesis of systems evaluation and dissemination research.

Tasks

- Site visits to ascertain state-of-the-art information
- Review of ICRAF Annual Reports, Location Reports, Journal Articles and other reports such as conference proceedings
- Analysis and Synthesis of Information
- Report development, writing and publication

ACTIVITY 11. METHODOLOGY DOCUMENTATION AND DEVELOPMENT

Objectives

(1) To provide research and extension personnel with a range of clearly documented choices of methods and approaches for Systems Evaluation and Dissemination research.

(2) To develop innovative research and dissemination approaches which maximize the efficiency of participatory systems evaluation and the rapid and targeted dissemination of promising innovations.

Tasks

- Identify which key generic activities of systems evaluation and dissemination are priorities for methodology documentation
- Review and analyse current approaches/methods utilized in such activities both at ICRAF and elsewhere
- Identify success and limitations of contrasting approaches
- Provide succint documentation of methodology options to a range of audiences (activity dependent)
- Where required, develop, test, evaluate and report on new methodologies, often in collaboration with other ICRAF Projects and institutions.

ACTIVITY 12. CONFERENCES/WORKSHOPS/PUBLICATIONS

Objective

(1) To ensure that staff of ICRAF and our collaborators are fully aware of state-of-the-art research and approaches in their respected fields of expertise

(2) To expose the external research and dissemination community to the achievements of ICRAF's Systems Evaluation and Dissemination Research.

Tasks

- Identify most appropriate conference or publication forum
- Follow standard ICRAF procedures for preparation and review of papers for presentation/publication
- Prepare and distribute trip report of key information obtained at conferences/workshops etc.

ACTIVITY 13. DEVELOPMENT AND MANAGEMENT OF ADAPTIVE RESEARCH AND DISSEMNATION TEAMS

Objectives

- To create coordinated, effective and sustainable adaptive research and dissemination teams comprising a range of partners working in priority pilot project areas.

Tasks

- Identify most appropriate research and dissemiantion partners in pilot areas (see also Activity 6)
- Hold initial workshop to share information on goals of ICRAF and potential partners
- Confirm members and Adaptive Research and Dissemination Team, and agree on common goals and approaches (MOU's)
- Hold regular meetings to review programs and plan for the future.
- Agree on comprehensive and common mechanisms for data collection, analyses and reporting of systems evaluation and dissemination results.

ACTIVITY 14. BACKSTOPING REGIONAL/GLOBAL RESEARCH AND DISSEMINATION

Objectives

- To ensure that teams in pilot project areas benefit from the collective expertise of ICRAF staff working at other locations, and exchange information with them.

Tasks

- Visits to pilot project areas (+ trip reports)
- Development and execution of collaborative research initiatives
- Experimental protocol review
- Internal review of publications
- Attend planning meetings (regional, country level)

ACTIVITY 15. PROGRAMME AND PROJECT COORDINATION

Objective

To ensure that ICRAF's financial and human resources are utilized in a cost effective and well targeted manner to meet the goals of Systems Evaluation and Dissemination Activities

Tasks

- Budget preparation and monitoring
- Allocation of resources to meet activity needs (cars, casual labour, equipment etc.)
- Human resource recruitment and evaluation
- Daily office correspondence/administration
- Hosting visitors to locations
- Regular staff meetings to review progress
- Liason with national and regional teams